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Editorial

The Cost of Quality Plate

Only a few years ago we had just a vague idea of quality in plating. Today we have specifications for plating steel—a first rate beginning. Further work will tell us much more; it may standardize the character of the plate—porosity, ductility, adherence, brightness, etc., as well as thickness. However, we repeat, we have made a good start.

Nor is there any dispute about the desirability of "quality plate". Everyone would like to produce a "quality plate" just as everyone would like to live in a "quality home," wear "quality clothes," drive a "quality car" and so on. And since we now have a fair idea of what quality plate is, there is left only one reason for producing anything else—the cost.

But this leads us into another uncharted sea. Granted that it costs more. (Quality always costs more!) But how much more? As much as it is possible to recover in the form of better prices for better products? More than that? Less? We do not know. No general statement can be made as almost every case is different from every other. Very likely most manufacturers of metal products would be hard put to it to give a "bullet-proof" answer to this question.

And yet no question before the plating industry has greater significance. No question more urgently needs an answer. No question is more worthy of the best thought of the industry.

Metallurgy and Civilization

Old and familiar as the subject is, strangely enough, we never tire of considering the contributions of metallurgy and metal products manufacture to the welfare of humanity. Perhaps our interest is due partially to the fact that it is in some small measure our contribution, and that recounting it is our "brag." We are quite willing to leave such analysis to analysts of whatever school of psychology they may belong. In the meantime we proceed with our "brag."

New and improved alloys have made possible the high development of the automobile, the airplane, airship, the Diesel engine and the high speed train. Perhaps the most spectacular form of improvement is the greatly improved strength-weight ratio which is now made possible in engineering construction. The use of small quantities of special metals, "addition agents," has given us properties which are not only far ahead of the old materials but which open roads to still greater improvement.

Powder metallurgy, a new departure in manufacturing processes is making possible the use of combinations hitherto believed impractical. We have today about 35 metals in active industrial use, many of which were formerly museum curiosities. We have perhaps over 8,000 different mixtures of ferrous and non-ferrous alloys, (which many of us believe is carrying progress too far; we would do with fewer formulae!)

If we took to citing instances, we could run on indefinitely. We can also tell the whole story in a very few words. Modern civilization would be impossible without modern metallurgy.

Scrap Metal Ramifications

No better example of the conservation of raw materials exists than the collection of scrap and the recovery of commercially useful metals and alloys. The enormous size of this activity would surprise all except those who are in close touch with the industry. E. W. Pehrson of the U. S. Bureau of Mines, estimates that from 1907 to 1936, 9,000,000 tons of copper; 5,000,000 tons of lead; 3,500,000 tons of zinc; 635,000 tons of tin and 682,000 tons of aluminum have been reclaimed from various cycles of use.

Scrap is now a most important material not only industrially but from a military aspect. Huge quantities are being exported from the United States to the countries most active in building up their armaments and whose own resources are inadequate. For example, our foreign shipments of iron and steel scrap increased from 228,000 long tons in 1932 to over 4,000,000 tons in 1937. Large as this tonnage seems, however, it is actually a very small part of the annual production of scrap from the 750,000,000 to 1,000,000,000 long tons of iron and steel in constant use.

Zinc and tin, the metals most generally used for coating iron and steel, are the hardest to reclaim since they are so widely distributed. Copper, lead and aluminum have long fed large volumes of scrap into the stream of manufactured metal products which naturally decrease consumption of newly mined metal. While this may seem to work hardship on the metal producers whose markets are thereby reduced, the use of scrap is an obvious necessity and must be considered a permanent factor in the production and manufacture of metals.

Lowering Finishing Costs By Press Shop Methods

Analysis of problems in producing fine plated finishes on cold rolled steel. How care in manufacturing saves money in finishing.

By **FREDERICK FULFORTH**
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AN EARLIER paper entitled "Steel for Plating Purposes", published in METAL INDUSTRY for March, 1938, called attention to the necessity for proper specifications in purchasing cold rolled strip steel for plated finishes; but since that time many questions and samples have been received, with complaints that although better steel was used, the costs remained the same, or increased, rather than following a downward trend. In practically all solutions of these problems the causes were discovered to be the methods employed in the press shop operations, the design of dies or any one of several allied reasons, none of which could be directly attributed to the quality of steel used. The results of these analyses have been summarized herewith to endeavor to prove a clean bill of health for the original steel specifications and to assist in securing improved press work for the plater to finish.

In the first place the answer to first quality press shop work is approximately 90% handling care, provided proper steel specifications are employed and precautions to assure this end commence with the receipt of stock and continue through the type of machines, methods of storing parts in manufacturing process, skill and training of operators and many others which are to be further considered in detail and illustrated.

So far as the skill and training of operators is concerned an actual occurrence will demonstrate this point.

A certain manufacturer decided to enter upon a new line of plated work for the very excellent reasons that he had developed some patents controlling the articles in question which were of a seasonal demand nature so that their heaviest schedule of manufacture would be required when his lightest schedule was needed in his other lines and therefore he could offer his press shop employees practically continuous employment; whereas heretofore they had a dull seasonal lay-off problem with which to contend. These men were all skilled operators of several years' average experience on heavy angle and light sheet iron punching, bending and forming work, but when transferred to the light metal stamping presses the whole idea had to be discarded since it seemed impossible to have these operators either produce sufficient work to meet the cost requirements of a competitive article, make a normal wage for themselves or refrain from having serious injuries on the small high speed presses involved. As a consequence, it was finally necessary to hire young men and girls with no previous experience and train them: first in safety methods and the careful use of safety appliances provided; second to build a feeling for fine quality work among them; finally the speed of production required developed of itself with but little trouble.

Fig. 1. *Shows manner of piling boxed stock with operator preparing to remove some from one of the boxes. Note the oiled paper which he is about to return to proper contact with the top sheet after removing lid of box.*

Steel Receival Inspection and Storage

In order to know that the type of cold rolled steel ordered is being received and properly cared for, certain simple regulations must be laid down for its storage and receival inspection. No elaborate procedure is required; merely a common-sense arrangement of a few items such as the careful piling of each size as a separate unit, the boxes being handled so as not to violently shift the sheets in them at any time, which might cause rub marks, possibly calling for polishing to remove. When so piled and not in use, the cover of the top box should be renailed after making sure a sheet of paper is in contact with the topmost sheet of steel. This will keep out shop dust and moisture, the former having a tendency to attach itself to the oily, protruding paper edges between sheets and scratch each successive sheet withdrawn to greater or lesser degree, thereby possibly marring an otherwise non-polished plated finish. This has shown to extreme disadvantage in bright nickel work where no buffing is employed.

Only sufficient sheets should be removed from the top box at any one time to perform the work in hand so that none is left lying around the shop, to collect dust or moisture, or to be replaced in the box at some later date, thereby creating extra handling hazards for gritty dust scratches or bad gouges caused by sliding a sheared end the length of the under sheet in the box when returning.

When steel is in process of receiving and piling, approximately upon reaching each 10% of the total order one

sheet should be removed from that box and its lid nailed shut immediately before adding to the pile. At the end of the shipment the sheets so selected should be carefully wiped free of oil and visually inspected for surface defects, slag inclusions, roll marks on either side, mill handling scratches, etc., and concomitantly checked for gauge, width and length.

The dimension check is important since a die designed to deep draw from .040 steel cannot be expected to draw from .045 without straining or breaking, and the time to make this discovery is upon receipt of the shipment and not after the die has broken.

Moreover, a difference of a fractional part of an inch in width or length should be realized at this time not only to save additional scrap losses, which would not amount to much, but to determine whether such stock will fit the dies intended for it rather than delay until they are set in the presses and then find it necessary to replace gauge pins or increase through slot clearances as in progressive blanking dies.

These same sheets should next have a short piece cut from the end of each one, the remaining long lengths promptly returned to the top box in the proper pile and the box closed.

Several of these pieces may now be checked for Rockwell hardness to see if that specification is up to standard and some of the others examined under the microscope for grain size.

It is no longer necessary to purchase a special microscope for this purpose, as eye pieces are now available which may be adapted to standard instruments at relatively slight cost.

Finally, if all these tests are satisfactorily passed, some of the sheet ends should be processed through any convenient die similar in its operation to that one for which the purchase was ordered. That is to say there is no necessity for setting up the exact die required for that particular job since a similar bend in any die or in a hand brake if no bending die is available, will give an idea of how the stock will withstand its final operations. If any doubt exists as to the quality of the bends the pieces may have a hole quickly punched in them at some random point, be hung on a rack and finished in the customary manner to determine just how this steel will appear at its critical bends in completed articles.

From all this miscellany it might seem a rather onerous labor to predetermine quality, but in practice it really is a very simple matter. In one shop everything is done by the foreman (except the grain size measurement which is sent to an outside laboratory) without interfering noticeably with his regular duties (although a day of some foreman's or inspector's time could be well spent on each arriving shipment and charged to trouble insurance).

Upon these random selections then, rests the decision to accept or reject the whole shipment. If rejection is contemplated the local mill representative should be immediately notified so as to start another heat through the rolling mill as soon as schedules permit, and in conference with him, the decision should be reached as to whether the rejected shipment is to be returned or retained for other work to which it is adaptable, perhaps at a price reduction in lieu of return shipping charges.

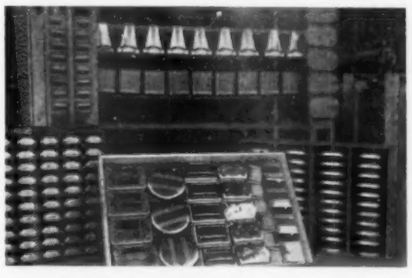


Fig. 2. Demonstrates various special racks, trays and boxes. The rack in the background is on four kiddycar wheels and is adaptable with its removable carriers to several types of large bodies, two of which are illustrated in position, while leaning vertically against its right hand corner is a carrier showing the removable wood block adapters for the large bodies in its upper half. The slanted tray in the foreground is arranged to show how many various parts may be fitted into a common design so that the important outside surfaces are in contact with nothing but air. The other boxes illustrate adaptations to specific articles.

Without this apparently multiplex procedure the plater frequently receives thousands of fabricated stampings with which it is not possible to produce a really good plated finish, while even an inferior passing one runs the cost sheet into the red with extra polishings, additional heavy deposition thicknesses to cover defects without nickel buffing through to the base metal, and other equally expensive post mortem makeshifts.

Operating Methods

As previously shown the first requirement is to have carefully trained, highly skilled operators without whom no good work will result. Equally valuable is a sympathetic attitude on the part of the foremen and die setters, since if they are of the type who can see no sense in careful handling and correctly planned work sequence as valuable to the plating shop, no help may be expected in the reduction of plating costs. Or perhaps this attitude should start higher, in the supervisory force, where it is sometimes lacking.

In a New England electrical appliance manufacturer's press shop all the dies are maintained in a separate locked vault under direct control of a journeyman toolmaker who issues them in first class order to the die setters upon their signature and he will only surrender their cards when the dies are returned with the last piece of the run made, attached to them in clean condition; whereupon a thorough inspection and checking occurs, disclosing any imminent failure to be repaired in the tool room previous to return to storage.

This method is unquestionably expensive, yet it pays dividends to justify its existence, so that each shop must determine for itself what money may be profitably spent along these lines to keep dies in perfect repair.

Incidentally, from careful questioning in many plants and of divers individuals, it would seem to be a well recognized rule that one die repairman is required for every three to four press operators so one may gauge one's shop efficiency with this regulation as a starting point.

The die setter has certain duties in well run shops to which he must rigidly adhere, that is, duties in addition to training in the correct procedure for safely inserting dies in presses (which will not be discussed here) being standard practice. He should, however, after the proper insertion of dies in presses, see that some other requirements receive consideration, namely:

1. He should have all arrangements so that the operator may begin producing immediately upon starting a

job, i. e., the correct surrounding equipment in place, including stands, chutes, work and scrap boxes, a supply of lubricant if needed, on hand, counters set to zero and proper stock boxes opened.

2. When all these minutinae are cared for he should operate the press himself for at least ten pieces or one full length of stock, if a blanking operation, and check the quality he obtains with the inspector or other higher authority before assinging an operator.

3. Upon starting the operator he should instruct him in the proper rhythm of work and call attention to the samples produced, their quality standard and location in assembly and disclose any information known relative to the piece in question, such as necessity for striving to avoid die marks, potential weak points which could break and make an incomplete operation, although difficult to notice, stripper mark possibilities, etc. Also explain why the job must be run as set, as well as definite knowledge of earning power or piece work rate.

In short, the operator must be made to feel that the entire responsibility for success of the operation in its larger unity of final finish and assembly now rests entirely with him, since he has all the information available and his importance to completion is tangible.

4. At the same time the operator should realize that quality is the prime consideration and his earning power secondary; but if for any *valid* reason his earnings fall below standard, average or some predetermined figure, his compensation will be adjusted if he can show the fault to lie in other than in his own hands.

Some shops do not pay operators for work spoiled through fault of theirs, which has worked well provided, when slowed without personal blame he receives legitimate extra compensation.

When blanking, the oiled paper packed between the steel sheets should be retained and the blanks stacked carefully in proper size boxes or hand trucks to avoid upset and they should be frequently inspected by the operator to see that excessive burrs are not developing, which would tend to scratch through the paper when one blank was drawn across the next below, in removal for the next operation.

The paper should at this time be lifted and an examination of the significant surface made for stripper, slug or other marks which could occur but be invisible through the paper.

The ideal arrangement is to have a set up of presses so that the blanks move piece by piece to the next operation and no stacking or piling is necessary; but this requires fairly large production shops with extra presses for this line up method to be worked economically, since a single press stoppage throws the whole line out of work and unless all operators can be moved to reserve machines, ready set, considerable time is lost.

Failing a continuous sequence cer-

Fig. 3. Pictures a corner of the die storage room showing the shelved tables and the adjustable height strolier with which the dies are wheeled to and from the presses without any hand lifting.

tain substitutions and combinations may be made to approximate its excellent results.

In designing the dies, as many holes as possible and as much extra work as feasible, may be incorporated in the blank, which tends to reduce the number of operations and makes piling a well protected process with the paper between blanks.

As soon as an operation is reached where the pieces no longer stack readily or where for some other cause the protective paper is torn or has to be discarded, a special container of convenient size is substituted.

This container may be of any permanent material *so long as the outside surface of the piece when finished will not contact anything but air.* This statement cannot be overstressed and is responsible for the elimination of more polishing than any other single caution used.

The containers should be of a kind that may be used over and over again and by careful design may be made applicable to several different parts. They should be so constructed that they may be piled easily and readily nested. Another advantage is the ease with which standard size containers for one or more items may be traced from shop to shop and give at a glance the total pieces available for any production operation since a rapid mental multiplication of the total in a pile by the known number of pieces in each is the answer.

In general, wood has been found the best material to use, first, because the boxes containing the steel are available when emptied, and being ¾″ thick, are found suitable both for size requirement and quality; while some of the 25 cents per hundred pounds paid to the rolling mill as a boxing extra, finds its way into an invisible profit channel.

As an illustration of the value of such carriers the writer made a study of one peculiar shaped part which did not lend itself readily to container application and was therefore handled in piles of twenty-five or so in trucks. A suitable box holding 100 pieces was finally worked out at what seemed an excessive cost of three dollars each in quantity lots. However, when put in use, the polishing cost for every hundred pieces was reduced by exactly the cost of one box while the boxes were usable many times over. The point demonstrated is that no matter how seemingly high the cost of a container is, that should be no deterrent until samples have proved its value or lack of value.

These containers, by having cards slipped into slots at their ends printed with shop symbols, may be used as a continuous check on each worker's production both for quantity and quality. As a box is filled the operator pencils his number beside his shop symbol on the card, which is repeated in each shop until the final assembly inspection, when a complete record exists of all the employees having performed any work on that particular box-full, and responsibility for defective work is readily placed.

By keeping all cards with defective

notations until the end of the month, or any other period of time, the names of those employees consistently appearing careless are checked, and when shown the result they usually improve during the next period.

Design of Parts and Dies

Primarily any article is produced for profitable sale but the difference of opinion between sales and production departments leads to some compromise to reach this conclusion. The best practice is intelligent consultation between the various departments interested.

For finishing purposes a round article with highlight surfaces well broken is admittedly the easiest piece with which to work. But, if the sales promotion department proves that only square highlighted articles are in demand by the buying public, that will probably be the shape adopted. However, some compromise may be made, by placing large radii on the corners and arranging for shallow recessed lines to break up all but one or more prominently highlighted areas at a greatly reduced finishing cost as well as tending toward keeping down final rejects to be refinished. The cigarette case and lighter manufacturers are an outstanding example of this type of work developed to its highest present degree.

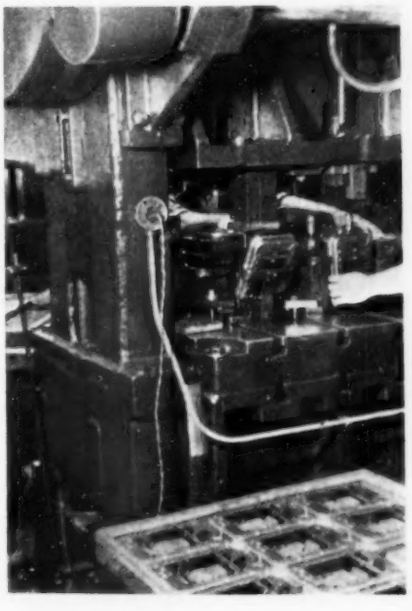
So much, briefly for sales and advertising appeal which, being an enormous subject in itself, cannot be more than barely touched on in the scope of this article, or in the hands of other than an expert in that line.

After the final styling has been approved by sales, advertising, engineering production and finishing departments, then and only then should the engineering department proceed to lay out the individual parts design.

Parts will of course be held to a minimum consistent with good engineering practice and special attention must be given to finishing problems. One instance where no attention was paid to finishing comes to mind when a wide, deep recess was provided on top of a chrome plated steel part to receive a small knob. The depth was so great and the width so enormous in comparison to the size of the knob that an inferior finish stood out like the proverbial sore thumb, and since it was absolutely impossible to get a good finish at such depths economically, the whole part had to be redesigned and new dies built for it.

Fig. 4. A typical small press forming operation. Note the work supply piled in the supporting chute at the operator's left hand, the handcuff safety devices on his wrists whereby his hands are pulled back from danger should the ram fall for any reason before he was prepared, the through chute allowing the finished pieces to fall out of his way by gravity due to the inclination of the press bed and the inspector in the rear, checking some samples from the finished work receiving box with a gauge.

Fig. 5. This picture shows two operators, one in front and one in the rear of the large press, perform a five die series of operations instead of setting five individual presses. Note that the operator nearest the camera is protected by the nature of the work done on his dies so that there is no necessity for him to put his hands in a dangerous position where they could be injured by an accidental movement of the ram. Note the finished work tray in the foreground and the pile thereof in the left background from which the operator on the other side of the press is withdrawing the work.



Again in the layout for dies, these should be designed to have as few operations as possible in order to make a piece with a minimum amount of handling, much of which can be cared for in the preliminary discussions of the various department heads. Nevertheless—go into any press shop running on production and one will shortly find extra added operations being performed here and there; or look among the archives of the tool room and the eliminated operation dies will be seen rusting into oblivion largely due to insufficient discussion before rushing into production.

As the exception which proves the rule it is not unusual to discover two rapid handling operations deliberately substituted for one of a slow handling nature, which is entirely legitimate, when the overall cost may be thereby reduced; and if careful consideration has been given to the hazard of additional handling with its consequently greater chances for handling scratches and die marks, difficult to conceal, in finishing without extra cost, the additional labor is warranted.

The evils of such additional operation may be minimized to some extent by setting a group of dies in one large press as illustrated in Fig. 5 of this article. In this particular case, five dies are grouped to be operated by two men and all holes pierced are here completed as well as some additional edge curling and slot depressing. Were these five dies run separately in five different machines the direct labor would be over twice as great while most certainly the hazards of scratches would be increased five fold.

Logically the suggestion is to make a single die to do all five operations but this was considered originally and because of the nature of the work the location of openings, high initial cost and other factors, the idea was discarded as uneconomical.

Continuing on die design theory as applied to finishing costs some brief analyses of failures may be helpful.

Whenever folds can replace bends or wide angle bends eliminate right angle ones, the results are beneficial in relieving orange peel effect and die marks.

Frequently a part is designed either without holes or with holes of a size too

small to use economically in racking for plating. A large hole may be incorporated in the original design of the blank for this purpose alone and found to obviate special rack design and even may be used for final assembly purposes to good advantage.

Whenever possible the size of a part should be made to conform to some standard container in present use, which keeps down the variety of these containers required, their repair and storage overhead and frequently results in using less metal, when shortening is allowable, to make a more desirable arrangement in the carrier.

All dies in use with high priced cold rolled steel should be of the best design and manufacture known, that is to say all exposed surfaces should be finish ground so that no tool marks can possibly leave their imprint upon the work either from the die or its strippers.

For the same reasons all screws should be Allen head in counterbored holes, and stops and gauges should be hardened, ground and neatly finished. On bending, folding and some drawing operations allowance should be made for hard chrome plating significant surfaces. The chrome should be there applied to oversize, then ground and polished to a smooth size finish.

Process Inspection

A trained inspector should be present in the press shop at all times, not to examine every piece made, but to keep moving around among the presses even if a stop only averages once every fifteen minutes, not only checking sizes, or gauging, but particularly on the alert for imminent die failure tending to spoil quality for plating.

In addition the foreman should see every job at least twice daily and the set-up man should check between the inspectors' visits.

Lubricants

A special heading is given to this subject because of its major importance.

Wherever additional oil or drawing compound is required other than that on the sheets when received from the rolling mill, a very careful selection must be made. Some compounds, especially the so-called cushioned ones, are excellent for drawing purposes but well nigh impossible to remove previous to plating without entering upon expensive special procedures.

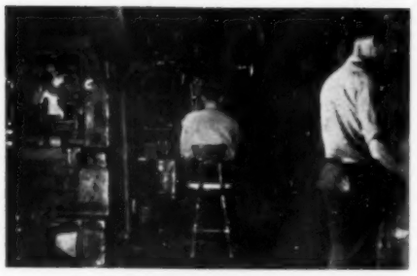


Fig. 6. A combination whereby two men operate three dies in the large press partly visible to the left. As their operations are completed the piece is laid on the outswing press knee at the left of the operator, whose back is to the camera. This press is portable and may be pulled into position wherever required to follow operations on large presses too unwieldly to move. The welder at his machine on the right takes the part directly from the operator whose back is turned, spot welds in two places and puts the finished article on the truck rack partly visible behind him on the right of the picture whereupon five operations have been completed in a single handling on three machines using four men with a large unwieldy part extremely difficult to handle in any other way without scratching.

Moreover, some otherwise excellent compounds clean easily if followed quickly by plating operations, but if work is stored for a week or so, they dry and cake, and not infrequently, being hygroscopic, pick up moisture from the air thereby accelerating normal oxidation.

Rusting also occurs with the use of cheap slushing oils made from the last residue of gasoline cracking and too frequently supplied by rolling mills in the past, if a more expensive substitute is not specified by the purchaser.

Finally, schedule requirements should be accurately estimated for the reason that if excessive amounts of process work lie around for long periods, often moved to make room for more urgent orders, the shaking around and handling adds enormously to the finishing costs as does also the increased possibility of rust.

In this connection storage should occur in as dry an atmosphere as possible, certainly far from the plating shop where the damp air, after all machinery and exhausts are closed, acts as a steam chamber spreading through all open doors in the building. If stored as steel parts, there should always be heat present in cool weather as a very slight drop below the dew point precipitates sufficient moisture to create a fine film of rust all over the exposed surfaces.

Problems in Nickel Plating

An interesting and instructive discussion of nickel plating is embodied in a paper on this subject written by *Dr. S. Wernick*, and read before the Electrodepositors' Technical Society in London, England, December 15, 1937. The author had recently returned from a trip to the United States and his comparison of American and English practice is illuminating.

In nickel plating practice one finds totally varying concepts of such important points of technique as the use of high or low pH solutions; continuous or intermittent filtration; depolarized or cast carbon type nickel anodes. Air agitation, very popular in some places is opposed in others.

The author points out that during the last decade remarkable progress has occurred in the following:

1. Practical improvements in established plating processes.
2. Development of new industrial plating processes.
3. Development of plant to expedite and mechanize plating.
4. Closer control of plating processes and plated product.

Three of the most important attributes of a nickel deposit on steel are: (1) uniformity; (2) absence of pitting; (3) absence of roughness.

The author describes the methods of achieving these properties. He also discusses the various bright nickel processes in use.

One important difference exists between British and American practice. American platers are careful to clean the work before chromium plating whereas in England the chromium solution is made to act as a cleaner as well as a plater.

Methods of Joining Copper Alloy Products. Part 6: Sheets

Welding methods have become vitally necessary (a) as an element in facilitating design, (b) as an economical manufacturing method, (c) as an air to good service performance and (d) as a convenient means of making repairs. Examples are taken and analyzed to help the designer, shop superintendent and welding operator to a better understanding of the problems involved.*

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Effect of Alloying Elements on Welding Operations

In the lists of alloys given in Tables 6 and 7[1], we note that in addition to copper a total of ten elements are used in the manufacture thereof, namely: 1. Oxygen, 2. Phosphorous, 3. Zinc, 4. Tin, 5. Silicon, 6. Nickel, 7. Iron, 8. Manganese, 9. Aluminum, 10. Beryllium. These elements, used singly with copper or in combinations of two or three in copper, affect the properties of the resulting alloy in various ways. The following notes will be helpful in understanding the effect of each on the resulting alloy:—

Oxygen:—Oxygen is not readily soluble in copper either as the gaseous element or the copper oxide. Moreover, atmospheric oxygen has only a slight surface effect on copper at ordinary temperatures aiding in the development of a thin superficial green coating known as "patina" which may last for centuries without further change.

On the other hand, at the melting temperature of copper, copper oxides (the red cuprous oxide and the black cupric oxide) are readily formed and the former is dissolved in the molten bath. As the copper solidifies and the temperature drops, the cuprous oxide is thrown out of solution almost completely, existing thereafter in the solid copper as small specks and streaks of cuprous oxide or areas of the copper-cuprous oxide eutectic.

In the manufacture of the usual oxygen-bearing electrical bars and wires and commercial copper sheets, the oxygen content is restricted to a low value of the order of .02 to .07%. In such amounts it has no adverse effect on the physical or electrical properties of the copper. It does, however, have a decided effect on the welding properties.

For instance, if the copper is welded at temperatures above 1550° F with any type of gas torch having free hydrogen in the flame, there is an embrittling effect due to the reducing action of the hydrogen on the hot cuprous oxide. This reaction makes a weakened zone a few thousandths of an inch below the line of fusion in the base metal. This weakness is noted in bronze welds as well as fusion welds in electrolytic copper base metal. It may, in aggravated cases, cause a 50% reduction in the strength of a welded connection.

The other weakening effect may occur in any type of weld whether there be hydrogen present or not. Thus in a carbon arc weld where the heat is applied slowly, as for instance a weld in copper sheet made at one inch or less per minute, an embrittling effect is noted due to the collecting of the cuprous oxide at the grain boundaries. If the carbon arc weld is made rapidly, as for instance at 10 or more inches of seam per minute, the cuprous oxide does not have time to coalesce and a weld of good strength is obtained.

A general conclusion drawn from the above is that where copper sheets are to be joined by welds having a good strength and toughness, a *deoxidized copper sheet should be used* and not the usual tough pitch, oxygen-bearing sheet. Deoxidized copper is subject to neither of the weaknesses described above.

Phosphorous:—This wax-like element, an essential constituent of our friction matches, is readily soluble in copper and is the most powerful deoxidizer available therefor. Nearly all of the deoxidized copper tubes and deoxidized copper sheets are freed of oxygen by the use of phosphorous. This phosphorus deoxidized copper is, as a rule, a very pure metal with .01 to .05% phosphorus remaining in uniform solid solution in the metal. Other deoxidizers as silicon, aluminum, zinc, lithium and beryllium may be used instead of phosphorus.

In fusion welding operations, the phosphorus in the molten copper volatilizes gently keeping the surface of the weld pool bright and free of oxides.

As indicated in Table 3[2], an alloy of approximately 7% phosphorus and 93% copper melting around 1300°F is an excellent, self-fluxing, hard solder for lapped or scarfed joints in copper that do not require high ductility.

Zinc:—By far the most important alloying element used with copper is zinc, making a wide variety of brasses containing from 5% to 45% zinc. The brasses are prized for their variety of colors from copper red to the typical brass yellow with the higher proportions of zinc. They possess excellent

[1] See Metal Industry, April, 1938, p. 229-30.

*Parts 1, 2, 3, 4 and 5 were published in our issues for Sept., Oct., Nov., 1937, Jan. and April, 1938.—Ed.

[2] See Metal Industry, October, 1937, p. 498.

strength and ductility and good resistance to many types of corrosion. Not the least valuable property of the brasses are their workability. In one specific alloy or another, they may be case, forged, hot or cold rolled, spun, drawn into fine wire or into tubes. Wire and sheet are obtainable in a wide range of cold work tempers from the highly ductile annealed metal to the high strength, resilient spring temper.

The zinc lowers the melting point until with 50% zinc the remainder copper, we obtain the usual spelter solder, Table 3[3], melting around 1550°F. The entire range of melting temperatures of the useful brasses occurs between this low point of 1550°F and the melting point of 1949°F which applies to the 95 copper 5 zinc commercial bronze.

The brasses are readily soft soldered and silver soldered, being in this respect far superior to metals containing chromium, aluminum or magnesium.

The one property which is of concern to the brazing and welding operator conferred on the brasses by the zinc is the relative ease with which this constituent volatilizes from the melt. Pure zinc boils at 1665°F and, while being alloyed with copper, the vaporization of the zinc from the molten brass is partially suppressed, it has a strong tendency to vaporize at a comparatively low superheat above the melting temperature. Thus Muntz metal having 40% zinc alloyed with 60% copper has a boiling point of 1958°F. With only 1.5% zinc alloyed with 98.5 copper, the boiling point is raised to 3200°F. The boiling point of most of the commercial brass alloys falls in between these two temperatures, 1958°F and 3200°F. As soon as the zinc vapor escapes from the surface of the molten brass, it burns to the familiar white zinc oxide smoke.

Tin:—Like zinc, tin hardens the copper and increases its strength until, with 10% of tin and 90% copper, the familiar gun metal bronze, we arrive at a hardness comparable to that of the 40% zinc, 60% copper brass. Unlike zinc, tin has a very high boiling point and, as far as this element is concerned, the bronzes will withstand a very high superheat, even under the intense blaze of the electric arc, without any very serious loss of tin.

An important constituent of the bronzes, however, is the deoxidizer, phosphorus being more widely used for this purpose than any other. So profound was found to be the effect of the phosphorus deoxidizer when its usefulness was discovered in the 1850s that its name was conferred on such bronzes, they being known since that time as "phosphor bronzes." The phosphorus in the phosphor bronze may be as low as .03% though it is in the harder bronzes sometimes as high as .60%. While the tin does not vaporize when the phosphor bronze is superheated, the phosphorus does, escaping slowly from the molten bronze and reducing whatever copper or tin oxides are present on the surface the resulting phosphorus oxide escaping as a gas. This action explains the clear weld pool so often noted when using phosphorus bronze welding rods. Owing to this loss of phosphorus, the phosphor bronze should not be over-heated more than is necessary, nor held too long in the molten condition.

Zinc is occasionally used as a deoxidizer in the tin bronzes. The familiar cast gun metal made up of 88% copper 10% tin deoxidized with 2% of zinc is an example.

The tin bronzes are prized for their pleasing characteristic bronze color and their extraordinarily good wear resisting qualities.

Silicon:—Like phosphorus, silicon is a powerful deoxidizer for copper and has long been used for this purpose. One advantage it possesses over phosphorus is that it has a less adverse effect on the electrical conductivity of copper than the latter. Hence it was used as a deoxidizer in telegraph wires as early as 1883. It is, also, a very desirable major alloying element for copper improving both strength and ductility. The now familiar "Everdur Silicon Bronze," patented in 1925, is one of the earliest and best known of these alloys.

Silicon also improves the weldability of the alloy in which it is used. Unlike phosphorus, the silicon oxide alone is a rather refractory solid but in the presence of one or more other metallic oxides, as those of copper, manganese, zinc and tin, it forms a fusible glass film which covers the weld pool and protects the weld metal from further contamination with the atmospheric oxygen or the welding gases.

Nickel:—This metal has long been associated with copper in such familiar alloys as the nickel silvers, the cupro-nickels and Monel metals. Its general effect on copper is to improve the strength and corrosion resistance and to raise the melting point of the alloy. In increasing amounts it causes the alloy to lose the copper red color until with 25% nickel 75% copper, we have the nickel-white color of the United States five cent piece.

The nickel oxide is a tough, refractory, unfluxable solid at the usual melting temperatures. Hence a deoxidizer is required to cleanse the metal and precautions must be taken to avoid the formation of nickel oxide in welding operations.

Iron:—This element is only slightly soluble in copper and has comparatively little beneficial effect on the binary alloy. In manganese bronze, iron acts as a hardening and strengthening agent. It offers no difficulty to welding operations.

Manganese:—Acting in the role of deoxidizer and desulphurizer, manganese makes an important contribution to the quality of the nickel silvers, the cupro-nickels and the manganese bronzes. In larger amounts up to 1½% in "Everdur Silicon Bronze" it modifies the alloy beneficially and makes the scale more fusible. The manganese oxide is rather easily fluxed. On the whole, manganese offers no obstacle to welding operations.

Aluminum: — The aluminum bronzes carrying 5 to 10% aluminum, the remainder copper, have some valuable physical and corrosion resisting properties. The aluminum appears to improve the hot working properties and greatly accelerates the cold working effects. On being heated, the aluminum bronzes develop a thin, scarcely discernible film of oxide on the surface which prevents further scaling on prolonged heating at moderate temperatures.

The aluminum oxide makes a tough, refractory film on the molten metal which interferes greatly with fusion welding or brazing operations.

Beryllium:—Though present to less than 3% in commercial alloys, beryllium additions to copper come the nearest to a realization of the old

[3] See Metal Industry, October, 1937, p. 498.

alchemist's dream of hardened copper. Possessing excellent hot working and cold working properties, the alloy also responds sharply to heat treatment.

The beryllium oxide is even more refractory and unfluxible than the aluminum or the nickel oxide. It makes brazing and oxy-acetylene fusion welding practically out of the question. Under a very hot carbon arc, fusion welds may be made so rapidly as to forestall the formation of the oxide. Good welds are thus obtained.

Other elements:—There are a dozen or more additional elements which are occasionally used in copper alloys but which are not included in the above discussion as such alloys are not often offered commercially in sheet form.

Cadmium, chromium, lead and arsenic are examples. The first named makes a solid solution type of alloy, improving the strength without depressing the electrical conductivity seriously. Cadmium copper is, therefore, used more for electrical wires than for sheets. Chromium and lead are only slightly soluble in copper. The former makes a precipitation hardening alloy useful for resistance welding electrodes.

Lead is a useful and frequent constituent in copper alloy pipes, rods, forgings, extruded shapes and bearings in which materials it exists chiefly as small globules and films which greatly improve machineability and wear resistance. It is less frequently employed commercially in rolled sheets and plates. The lead melts and begins to stew out of the alloy as soon as its melting temperature 620°F is reached. Arsenic is used chiefly in heavy copper sheets for locomotive fire boxes. It raises the annealing point and improves the copper for such severe service. It offers no obstacle to welding processes.

Preparation of Surfaces and Edges

As will be understood from the remarks above on various oxides, a surface of any copper alloy sheet which is to be soldered, brazed or welded should be free of scale and oxides. It should also be free of dirt, grease and carbon in any form. Any such films are prone to give trouble in joining operations.

An illustration of the importance of having the metal chemically clean was furnished in the manufacture of a product in which some pieces of cold drawn flat brass wire were to be soft soldered to brass pins. In order to facilitate the soft soldering operation, the flat wire was tinned by the manufacturer. It was then given a light cold draw to secure exact size and a high gloss finish.

On attempting to solder the tinned flat wire to the pins using a dip bath of 50:50 lead tin solder and a non-corrosive paste flux, it was found that the solder would not adhere to the tinned wire. This was a surprise as the tinned surface was, on close inspection, apparently clean and bright. On investigation, it was found that there was a film of drawing compound too thin to be visible or to be detectable by the feel. A quick dip in a degreasing solvent such as a hot potassium hydroxide solution corrected the difficulty at once—the solder then ran to the tin coating avidly.

Similarly in bronze welding, though higher temperatures approximating 1650°F are used, grease or carbon must be eliminated from the surface before a strong bond between it and the bronze can be secured.

Preparation of the Edges

Having made certain that the surfaces are chemically clean, it is necessary to plan the joint (a) in order to facilitate the welding operation itself and (b) to insure the highest efficiency for subsequent service. In general, the butt weld of Figure 14 is usually the most economical to make and the strongest and most serviceable in use.

In Figure 14(a) the edges are upturned (1) to provide adequate weld metal (2) to stiffen the edges thereby discounting the tendency for the thin sheets to warp out of line and (3) to provide a convenient grip for the clamps or a desirable part for tacking.

Figure 14(b) shows a somewhat similar preparation except that only one edge is upturned thus saving one operation. The upturned edge is not bent to the full right angle as it is desirable to have the metal centered over the joint. Figure 14(b) is appropriately used for somewhat thicker

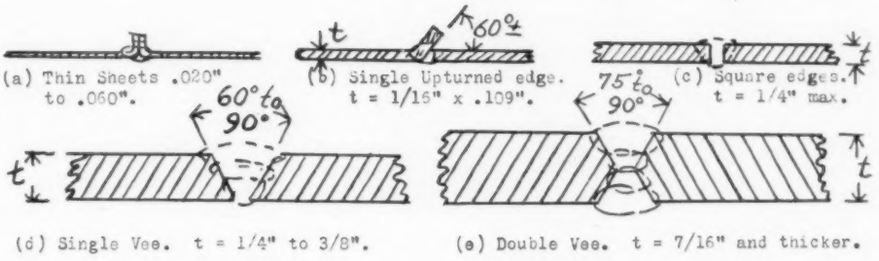

Figure 14. *Various edges prepared for butt seams.*

sheets than is the case with Figure 14(a).

Figure 14(c) is the usual square edged butt welds used for sheets from 1/16″ to ¼″ in thickness. Frequently the edges are closely abutted and tacked as a preliminary to the running of an arc welded seam. In gas welding the opening between the edges usually increases in the direction of welding about 2% of the length of the seam—this amount taking care of the contraction due to cooling of the weld metal.

Figures 14(d) and (e) show the type of preparation usually given to thick copper and "Everdur Silicon Bronze" sheets. The double bevel requires less weld metal for a given thickness of sheet than the single bevel but usually calls for an extra pass.

If one of the sheets in a butt weld is thicker than the other, a bad concentration of stress is likely to occur where the thinner sheet joins the thicker one. This evil effect is accentuated if it occurs at the weld. Hence, the preparation indicated in Figure 14(f) is recommended. The reduction of the thicker sheet to the thickness of the thinner one at the weld and an appreciable distance therefrom permits the weld to be made under sym-

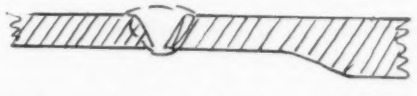

Figure 14 (*f*). *Sheets of different thicknesses.*

metrical heat conditions and locates the zone of stress change in the homogeneous base metal where it can not affect the weld.

Most often the edges of heavy sheets are cut in an edging planer but the method illustrated in Figure 15 used by the German coppersmiths has some decided advantages. The vee swaging tool is mounted most conveniently in an air hammer and the edge given a

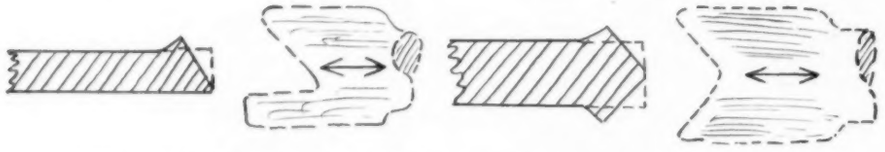

Figure 15. *Beveling edges by use of swaging tool in air hammer.*

single or double bevel as indicated. One worthwhile result of this method of preparation is that the excess metal is placed in the most convenient position for a very desirable weld reenforcement. By having a helper heat the edges to a dull red with an oxy-acetylene torch a few inches ahead of the air hammer, the operation is facilitated greatly.

Figures 16(a) and (b) indicate the usual form of lap weld employed in riveting, soldering, silver brazing and resistance seam and spot welding. The length of overlap, L, will depend upon the type of joint and the strength desired. The scarfed joint of Figure

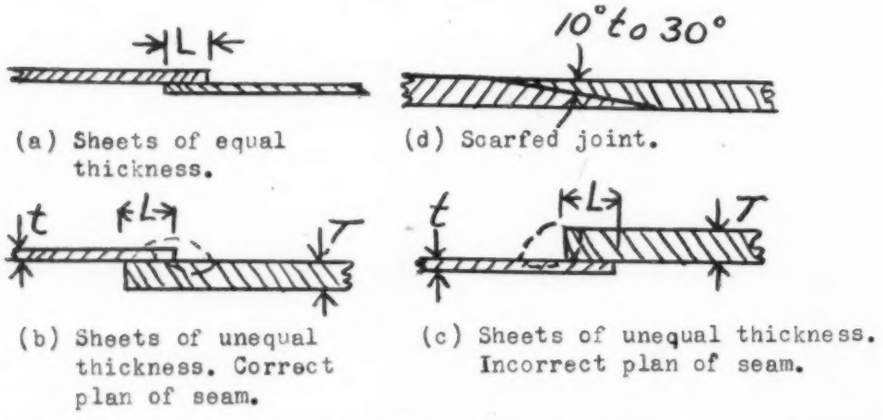

Figure 16. *Lap joints as used in soldered, silver and spelter brazed and fusion welded seams.*

16(d) is more often used in silver or spelter brazing than the straight overlap of (a) and (b). When the weld is a fusion process as in an oxy-acetylene or arc weld, the heat should be directed against the heavier sheet as in Figure 16(b) and not against the thinner sheet as in Figure 16(c).

The edge weld of Figure 17 is occasionally used in the manufacture of light containers where the thickness is greater than that convenient for double seaming.

Planning the Joining Operation

Whether the connection be riveted, soldered, brazed or welded, the designer should know not only the stresses involved but also the most efficient manner of performing the joining operation itself. Sometimes when there are only a few joints or possibly only one to be made, the procedure must be left to the operator. In general, however, careful planning will help appreciably in securing strength and uniformity. For one thing, *speed* is often a desideratum not only as a matter of economy but also because of the beneficial effect on the metal itself. Hence, back-up plates, holding jigs, clamps, wedges, auxiliary heat and properly prepared surfaces will generally more than pay for themselves.

Back-up plates:—Perhaps the most useful backing-up plate material is high conductivity electrolytic *copper*. It can be readily machined or bent to the desired shape. It is sufficiently hard and tough to withstand considerable wear and abuse. Its high heat conductivity will, in many, though not all, operations allow the weld metal to flow against its smooth surface without sticking thereto. Even when

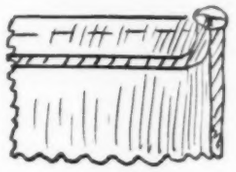

Figure 17. *Edge weld. Bronze or a fusion weld.*

the melting temperatures of the weld metals are higher than that of the copper backer, the latter may often be used as a backing up plate. For instance, copper blocks are often used as stools on which steel ingots are poured.

Figure 18 illustrates the profile for a weld in copper alloy sheets with square or single vee edges which are clamped against a copper backer. The small groove "a" centered under the seam allows full penetration of the

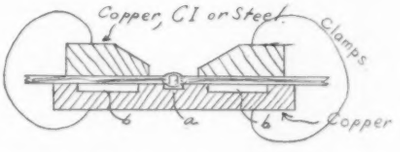

Figure 18. *Set-up for weld using typical copper backer.*

weld. The relief grooves "b" are merely to reduce the heat flow from the sheet into the backer.

The type of backer illustrated in Figure 18 is ideal for carbon arc or metallic arc welding of copper alloys but is rather unsatisfactory for oxy-acetylene welding. The slower operation of the gas torch, as compared to the electric arc, allows too great a heat flow into the backer. The result is to make the operation still slower or to cause imperfect penetration.

Asbestos sheet in thicknesses from 1/16″ to ¼″ makes a much better backing up material for oxy-acetylene brazing and welding. The heat loss is much reduced and, if the asbestos sheet is grooved under the center of the seam, full penetration is readily obtained.

Carbon plates are sometimes used for backers. They are usable for either gas or arc welding. They have a higher heat conductivity than the asbestos and wear away faster than the copper.

This series will be continued in an early issue.—Ed.

pH Studies of Alkaline Plating Baths

Experiments with silver, gold, zinc, brass and tin solutions. The application of buffers to alkaline plating baths offers interesting possibilities.

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In the work described in this paper, the following colorimetric indicators were used:

La Motte violet	pH 12.0-13.6
Sulfo orange	pH 11.0-12.6
La Motte purple	pH 9.6-11.2
Thymol blue	pH 8.0- 9.6

Copper

Recent studies on the Rochelle salt-copper plating bath[1] have shown that pH variations may be quite large and that the change of pH greatly influences the performance of the bath. The buffer curve for copper baths shown in Fig. 1 has been discussed but the conclusions that may be drawn from its study are generally applicable to a number of other plating baths. A brief summary of these conclusions is, therefore, justifiable.

The pH curve above 12.2 flattens out with increasing amounts of added alkali and above this value the pH will be relatively insensitive to small changes in the alkali concentration. A bath in this range will, therefore, be fairly well buffered.

In the absence of carbonate the pH below 12.2 will drop to a pH as low as 8.0 or 9.0 with very little decrease in the total alkalinity of the bath.

[1]Graham and Read, Metal Industry, November 1937.

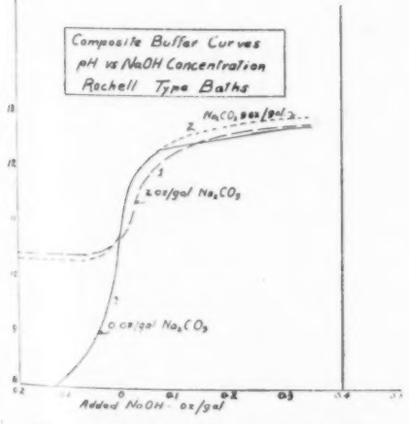


Fig. 1. Buffer curves for copper.

In the presence of carbonate the sudden drop in pH will be arrested at the 10.3 level until most of the carbonate is converted to bicarbonate and then may again fall abruptly to a much lower value.

In practice copper baths containing carbonate will seldom go below a pH of about 10.3. On the other hand a pH value between 10.7 and 12.0 will be more difficult to maintain.

Sodium cyanide in water has a pH between 11.0 and 12.0. If acid is added to lower the pH below 11.0 the cyanide is converted to hydrocyanic acid (HCN). When present in a copper bath as free cyanide where the pH is at 10.3 or below, it may exist as the acid and not as the sodium salt. Under these conditions loss of cyanide from the bath as HCN may be very rapid, particularly in hot solutions from which it can be evolved as a gas.

At a pH of 10.3 or below it is also possible to evolve carbon dioxide from a plating bath by taking advantage of the well known tendency for solutions of sodium bicarbonate to evolve carbon dioxide upon heating. It is actually possible to reduce carbonates in a plating bath by maintaining the pH slightly below 10.3 by the gradual addition of acid while heating the bath. The danger of poisoning due to cyanide fumes which are also evolved is a limitation to the practical application of the method. In a small scale test under conditions where precautions were taken against poisoning of any workers the carbonates in a copper bath were reduced from 9.1 to 4.2 oz./gal. in one and a half hours. The free cyanide was reduced at the same time from 3.7 to 1.5 oz./gal. indicating its volatility at the lower pH values. *It should be understood that this method of removing carbonate is not recommended because of its possible danger.*

Silver

A typical formula for a cyanide silver plating bath recommended by Blum and Hogaboom is given below.

	oz./gal.
Silver	3.5 Troy
Silver cyanide	4.4 Troy
Potassium cyanide (total)	5.0
Free cyanide	2.5
Potassium carbonate	5.0

The pH of this bath as made up is 11.7. From an examination of the constituents of the bath it would be natural to suspect the same type of pH curve as for copper. The curve for silver in Fig. 2 (p. 280) shows this to be the case. Above a pH of 12.0 the bath is less sensitive to small changes in alkali content. Below a value of 12.0 the pH falls very rapidly with small changes in alkali content and in the presence of carbonates the pH drop is arrested at the 10.3 level. In the absence of carbonates the bath may drop to a pH value as low as 8.0 or 9.0. It is interesting to note that Hogaboom in his recent study[2] of pH obtained the best silver deposits at pH values of 10.3 to 10.7.

Gold

Typical compositions for cyanide gold plating baths as recommended by Blum and Hogaboom are recorded below.

	No. 2 g/l	No. 3 g/l
Gold	2.1	4.2
Gold cyanide	4.6	9.1
Potassium cyanide	15.0	15.0
Disodium hydrogen phosphate	4.0	
pH as made	11.0	10.8

[2]Convention Report, American Electroplaters Society (1937).

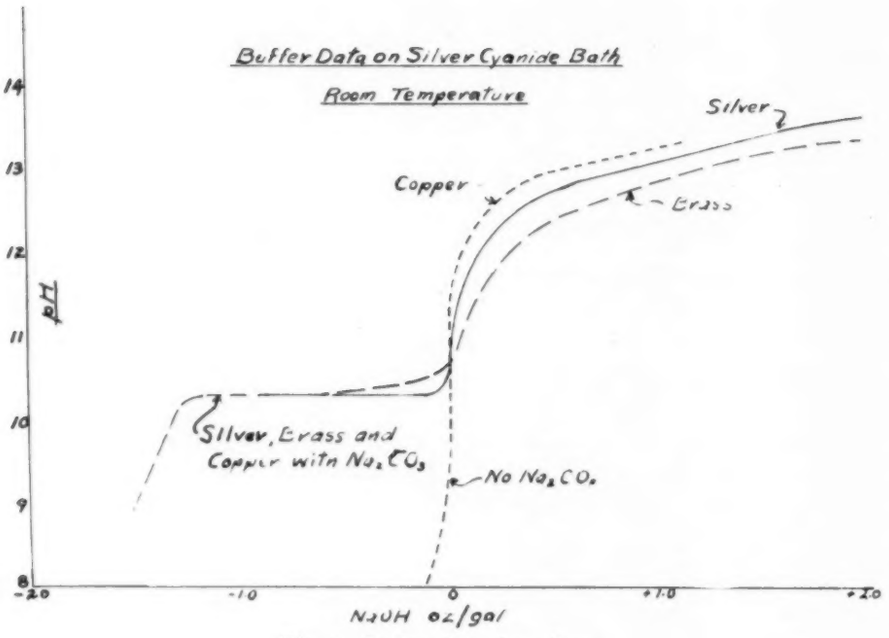


Fig. 2. Buffer data for silver.

The initial pH of baths 2 and 3 are 11.0 and 10.8 respectively. The curves showing the variation of pH with alkali content are given in Fig. 3. The gold curves have the same general characteristics as the curves for both silver and copper. Above 12.0 the pH is not very sensitive to small changes in the alkali content. Below 12.0, when no carbonates are present, the pH falls abruptly to as low as 8.0 or 9.0 with a very slight change in alkali content. In the presence of carbonates the pH drop will be arrested at the 10.3 level.

The pH control of these gold baths will be difficult in the absence of carbonate. Furthermore, since carbonates will build up in commercial operation it would seem desirable to add some carbonate on making a new bath.

Zinc

In an alkaline zinc plating bath the zinc may exist both in the form of a complex double cyanide and as sodium zincate. The buffer characteristics of such a bath might be expected to differ from baths having only a complex cyanide such as with copper, silver and gold. Several bath compositions were therefore prepared as recorded below, in the hope of obtaining information on the constituents in the cyanide zinc bath, as well as data on the pH characteristics of the bath.

Bath Z4 is the formula recommended by Blum and Hogaboom and has an initial pH of 13.5. The addition of extra NaCN to this bath up to 4 oz./gal. does not alter the pH as shown by the straight line Z4 in the upper left hand corner of Fig. 4 (p. 281).

Bath Z1 contains one normal (8 oz./gal.) zinc cyanide and 3 oz./gal. of both sodium cyanide and sodium hydroxide, i. e. enough cyanide and caustic to just dissolve the zinc cyanide. The initial pH is 12.7 and, as shown in Fig. 4, (p. 281) the addition of 4 oz./gal. of extra sodium hydroxide raises the pH to 13.5. The break in the curve is very likely caused by a shift in the equilibrium of double zinc cyanide to zincate as extra caustic is added, thus liberating some cyanide which does not affect the pH.

Bath Z2 is the same as Z1 with the further addition of 4 oz./gal. of soda ash. It has an initial pH of 12.4 and with the addition of 4 oz./gal. of extra caustic the pH is raised to 13.5. No break in the curve is apparent. The lower initial pH is due to the bicarbonate content of the soda ash used.

Bath Z3 is the same as Z1 with the further addition of 12 oz./gal. of soda ash. The initial pH is still lower (12.0) but the addition of 4 oz./gal. of extra caustic gives a curve entirely similar to Z2 and a final pH of 13.5 as before.

Cyanide Zinc Bath Compositions

BATH	$Zn(CN)_2$ oz./gal.	NaCN oz./gal.	NaOH oz./gal.	Na_2CO_3 oz./gal.	ADDED	INITIAL pH
Z1	8	3	3	..	NaOH	12.7
Z2	8	3	3	4	NaOH	12.4
Z3	8	3	3	12	NaOH	12.0
Z4	8	3	7	..	NaCN	13.5
Z5	8	6.8	..	..	NaOH	10.4

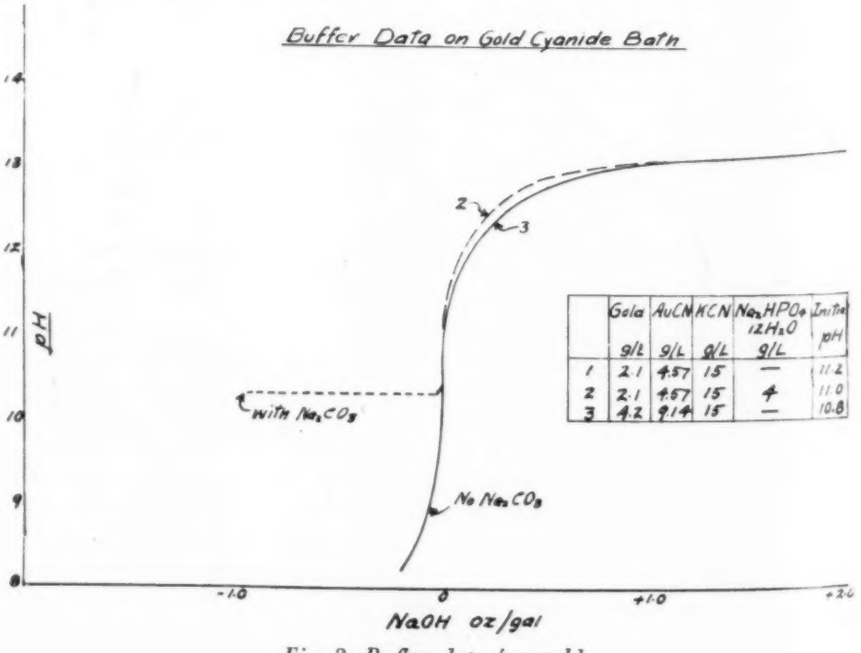


Fig. 3. Buffer data for gold.

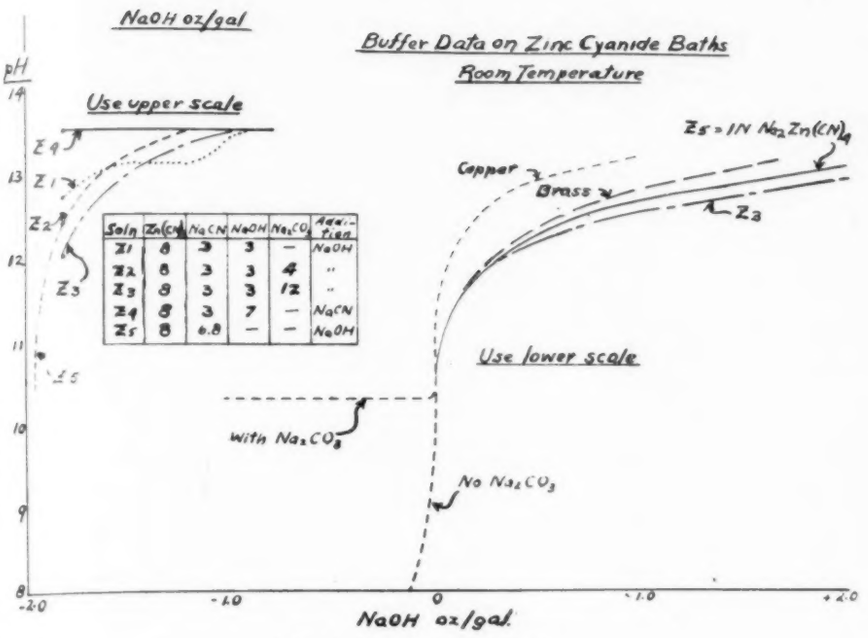


Fig. 4. Buffer data for zinc.

Baths Z1 to Z4, are all above 12.0 pH and with the additions of caustic or cyanide in the amounts normally present in commercial baths the pH is raised to the 13.5 level. It is evident that these baths will not be sensitive to small changes in total alkali and that the pH will remain fairly constant in operation. Furthermore, carbonates are not a factor in the pH range involved in zinc plating from alkaline baths. This undoubtedly explains why carbonates are not ordinarily recommended in making up such baths and may partly explain why the amount of carbonates that can be tolerated in a zinc bath is higher than in the case of copper, silver, gold or even brass baths.

Bath Z5 contains one normal (8 oz./gal.) zinc cyanide and just sufficient sodium cyanide, to form the complex double zinc cyanide. In the absence of caustic no sodium zincate is believed to exist. Variation of the pH is shown for the Z5 bath in both sets of curves in Fig. 4. The pH characteristics of this bath are not unlike copper, but the curve slopes more gradually to the right with the addition of caustic, finally reaching a level at a pH of about 13.5. The more gradual slope is undoubtedly due to an equilibrium shift between the complex double zinc cyanide and zincate, although no break in this curve is observed as the pH is raised. The negligible effect of carbonates at the high pH values involved with these baths is further illustrated by comparing the similarity of Z3 and Z5 in the set of curves at the right of Fig. 4.

Brass

Referring to the same set of curves (right hand set, Fig. 4) it may be noted that the pH curve for a brass plating bath lies between the curves for copper and zinc. Since brass baths are normally 80% copper and 20% zinc, the brass curve would be expected to more closely follow the curve for copper. Actually the pH curve for brass is almost the same as that for the zinc cyanide bath Z5. This means that a brass bath is better buffered than a copper bath because of the effect of the double cyanide zincate equilibrium shift occurring with changes in alkali content.

Unlike zinc, a brass plating bath may involve a wide range of pH and will be influenced by the presence of sodium carbonate. As the pH of a brass bath is lowered from 11.0 or 12.0 in the absence of carbonate, the pH will fall abruptly to 8.0 or 9.0 with very little change in alkali content. In the presence of carbonate a pH drop will be arrested, at the 10.3 level until most of the carbonate has been converted to bicarbonate.

Tin

Formulas for sodium stannate plating baths, usually vary from 6 to 18 oz./gal. They may or may not contain added alkali and rosin. Some baths contain added chloride, but in recent years sodium acetate has been largely used as a substitute for chloride.

While sodium stannate contains but a small amount of free caustic, its solutions are highly alkaline due to hydrolysis of the stannate. The initial pH of a 6, 12 and 18 oz./gal. bath is 12.2, 12.6 and 12.6 respectively. At these pH values the baths have sufficient alkali to be fairly in-

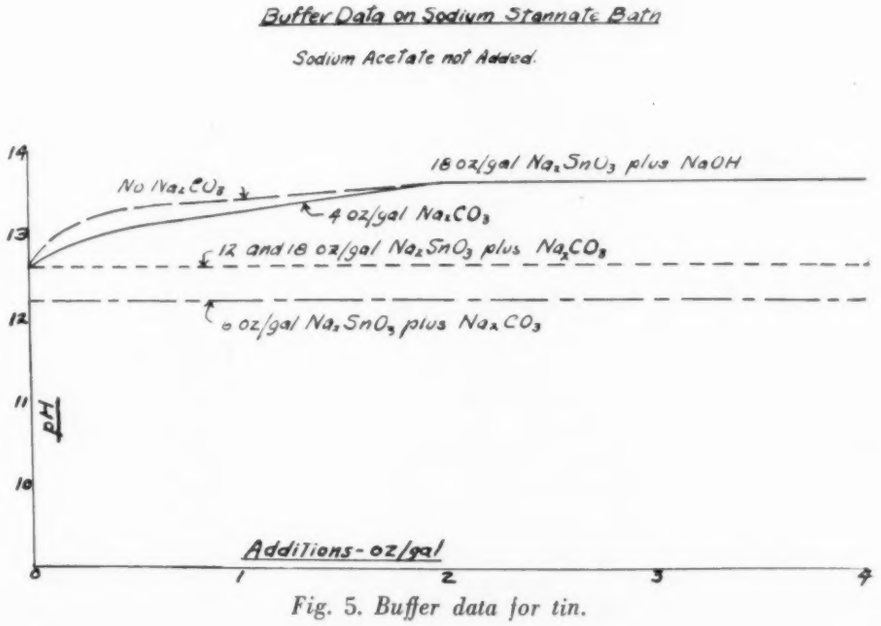


Fig. 5. Buffer data for tin.

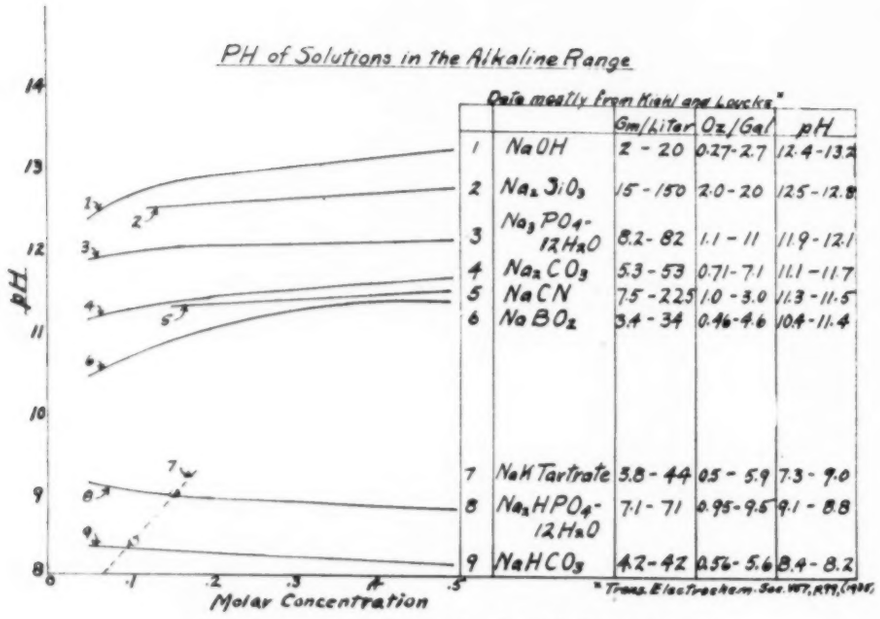


Fig. 6. pH of solutions in the alkaline range.

sensitive to small changes in alkali content. In other words the baths are well buffered.

The pH variation for an 18 oz./gal. bath as extra alkali is added is shown in Fig. 5 (p. 281). The curve is exactly similar to the copper cyanide curve in this pH range.

The addition of carbonate to fresh stannate baths does not change the pH at the high pH level involved. The dashed lines clearly illustrate this point.

The addition of caustic to a stannate bath containing carbonate (4 oz./gal.) gives a pH curve practically identical with a carbonate free bath. Advantage is taken of this in the suggestion recently offered by Oplinger for the analysis of free caustic in a stannate bath. By titrating with sulpho orange to a color change occurring at a pH of about 12.4 to 12.6, the free caustic may be titrated directly with standard acid. It is not necessary to remove the carbonates with barium nitrate, since none of the alkali of the carbonate is displaced above a 12.4 pH.

The pH curve for a stannate bath below a value of 12.4 is of little interest, because the tin is precipitated if the caustic concentration falls much below this value. Furthermore, the caustic content of stannate baths is carefully controlled in practice.

Conclusions

Studies of the effect of pH on the performance of alkaline plating baths are too recent and too limited in nature to enable one to draw more than very general conclusions. It should be noted, however, that copper, brass, silver and gold cyanide baths have very similar pH characteristics. All four baths may vary widely in pH during operation and the optimum pH may depend upon many other factors than the ease of pH control. The effect of sodium carbonate on the pH curves of all four plating baths is the same. Zinc cyanide baths of ordinary compositions will have pH values well above 13.0 and will be free from marked variations in operation. Sodium stannate baths will have pH values well above 12.0 and will not be subject to appreciable changes in normal operation.

Buffers

It has been shown that cyanide plating baths of copper, brass, silver and gold, in the absence of carbonates, are not buffered below a pH of about 12.0. Furthermore in the presence of carbonates a buffered level exists at a pH of about 10.3. The pH range between 10.7 and 12.0 in the latter case is still unbuffered and the pH will vary rapidly in this range during operation of the baths. Where no pH control is applied in practice these baths will frequently have a pH value of 10.3 to 10.7. In the special case of the Rochelle-salt copper bath the pH is maintained at higher (12.2 to 12.8) pH values by additions of caustic soda. To maintain such a bath at a pH between 11.0 and 12.0, while not impossible, is most impractical because of the constant attention required. If, however, a buffer compound could be found that would function within this pH range, the difficulty of pH control would be eliminated. It would then be possible to operate within this pH range without control difficulties, provided there was some operating advantages in doing so.

Kiehl and Loucks[3] have published some data on the pH of solutions in the alkaline range and some of their results are recorded in Fig. 6 (p. 282).

[3]Trans. Electrochem. Society, V57, P99 (1935).

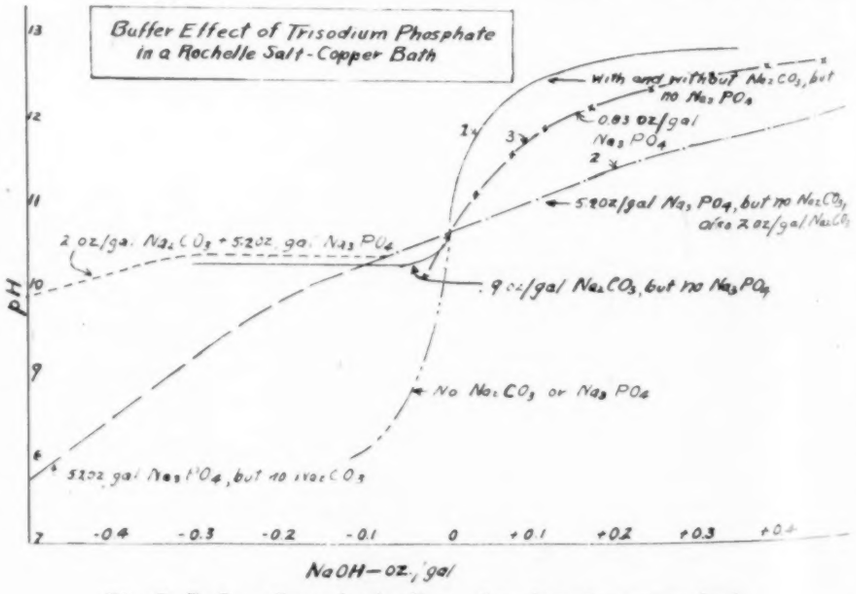


Fig. 7. Buffer effect of trisodium phosphate in copper bath.

It should be noted that sodium carbonate solutions have a pH between 11.0 and 11.7 for concentrations between 0.7 and 7.1 oz./gal. In plating baths the buffer effect of carbonate is exerted slightly below this range at a pH of about 10.3. One would therefore suspect that trisodium phosphate, which has a pH in water solution of 11.9 to 12.1 for concentrations of 1.0 to 11.0 oz./gal., would exert a marked buffering effect in plating baths at pH values from 11.9 downward. This has been found to be the case.

Rochelle-salt copper baths were prepared as recorded below and their pH characteristics with varying caustic additions were determined.

In Fig. 7 the pH curve No. 1 is for bath No. 1 and shows the typical buffer curve for a copper bath containing carbonate. The lower portion of the copper curve, numbered 4, is for bath No. 1 containing no carbonate at pH values from 10.3 downward.

Curve No. 2 for bath No. 2 shows the strong buffering effect of an addition of 12 oz./gal. of tri-sodium phosphate to a copper bath. In the absence of carbonate the curve extends through the 10.3 pH range at practically the same slope. With carbonate present the curve flattens at the 10.3 pH level due to the carbonate influence.

Curve No. 3 is for bath No. 3 which contains 2 oz./gal. of tri-sodium phosphate, but no carbonate. This small addition is sufficient to greatly improve the buffer characteristics of the copper bath. Four or six ounces would probably be better although the allowable amount must be determined by the effect of such additions on the character of deposits and on the anode performance.

Whether tri-sodium phosphate, a silicate or some other buffer salt having the proper pH value will serve best, depends upon the metal bath in question and the specific chemical and electro chemical effects involved. It is believed, however, that the application of buffers to alkaline plating baths offers interesting possibilities.

Bath Compositions*[4] *in oz./gal.

BATH No.	1	2	3
Copper	2.5	2.5	2.5
Copper cyanide	3.5	3.5	3.5
Sodium cyanide (total)	4.6	4.6	4.6
Sodium cyanide (Free)	0.75	0.75	0.75
Sodium carbonate	2.0	2.0	...
Rochelle-Salt	4.0	4.0	4.0
T.S.P. ($Na_3PO_4.12H_2O$)	...	12.0	2.0
T.S.P. (As Na_3PO_4)	...	5.2	0.83

[4]Similar compositions, omitting the sodium carbonate, were also prepared for 1 and 2.

Black on Bronze

Q.—We plan to obtain a dull black finish on machined bronze castings. We have thought of Parkerizing these castings, but in order to do this, we would have to cover them with an iron plate. Have you any information as to whether this would be the best method of handling the work? We are in the motion picture business and have a problem of halation caused by a gleam of light reflecting from the machined bronze casting. Can you help us overcome this problem?

A.—Iron plating can be tried but we have no data on how successful Parkerizing over this will be or the type of adherence obtained.

One procedure that can be tried is to deposit a cyanide copper and then oxidize in liquid sulphur or some oxidizing liquid.

Another possibility is a baking flat black enamel. Suggest you get in touch with lacquer manufacturers.

Also, a black nickel plate can be applied.

For black nickel plating use:

Single nickel salts	10 ozs.
Double nickel salts	6 ozs.
Zinc sulphate	5 ozs.
Sodium thiocyanate	2 ozs.
Water to make	1 gal.

pH 6.6. Do not use over 1 volt. Gas carbon anodes.

Before black nickel the metal can be given a matte finish by dipping in:

Sulphuric acid	1 gal.
Nitric acid	1 gal.
Zinc oxide, or sulphate	to saturation

Operate hot and keep all water and chlorides from the dip.

Sand blasting will also produce a matte finish that can be applied before the black coating is used.—G. B. H., Jr.

Cheap Rose Gold

Q.—A number of articles are appearing on the market with cheap rose gold finish. The articles are very attractive but it seems that very little gold is actually used. Have you any information of this type of finish?

A.—It is possible to produce an inexpensive rose gold finish on brass. It is essential however, that the base metal be brass otherwise no uniform results can be obtained.

The article to be finished is first immersed in the following dip until a deep red smut is formed on the surface:

Copper sulphate	16 ozs.
Muriatic acid	½ gal.
Water	1 gal.

Dissolve the copper sulphate in water and then add the acid. Use at normal temperature. A stone crock can be used for a container.

After the deep red smut has been formed it should be lightened somewhat by placing in a saturated salt solution for a few seconds and then rinsed in clean cold water. Plate in a fine gold solution for about 30 seconds; then relieve high lights with a fine brass or tampico wheel with bicarbonate of soda. After relieving plate for a few seconds in the same gold solution, dry and lacquer.

The fine gold solution may be made up as follows:

Sodium gold cyanide	½ oz.
Sodium cyanide	½-1 oz.
Disodium phosphate	2 ozs.
Water	1 gal.

Temperature 120-130 deg. F. Current density 1-5 amps./sq. ft. Insoluble stainless steel anodes or 24 K gold anodes may be used.—T. H. C.

The Electrodeposition of Metals from Non-Aqueous Solutions

Ethanolamine seems to give much promise as a solvent from which metals may be deposited electrolytically.

By **THEDFORD P. DIRKSE and H. T. BRISCOE,**
Department of Chemistry, Indiana University

IN RECENT years the electrolytic deposition of metals from non-aqueous solutions has received considerable attention. Audrieth and Yntema[1] used acetamide and formamide as solvents and obtained several deposits. Later Audrieth and Nelson[2] electrolytically deposited several metals from solutions of their salts in glacial acetic acid. This paper also gives references to other investigations in which pyridine, acetonitrile, acetone and liquid ammonia have been used as solvents. Booth and Torrey[3] have succeeded in electrodepositing beryllium from several solutions of its salts. They used methyl ether-boron fluoride, aniline, pyrrole, piperidine, pyridine and anhydrous liquid ammonia as solvents because they found that beryllium could not be deposited electrolytically from aqueous solutions of its salts.

In our work different solvents and salts were used to find solutions (besides those already investigated) that would give metallic deposits upon electrolysis. The main interest was in obtaining a deposit and no attempt was made to improve on the deposits that were obtained.

In all the experiments the cells consisted of 100 cc. beakers containing the solution to be studied. Platinum anodes were used. All electrodes were approximately one centimeter square. The salts were chemically pure, analyzed materials. The solvents, except acetamide, formamide and benzoyl chloride were distilled once before using. All solvents and salts were of the highest degree of purity obtainable. The salts were carefully dried prior to use. In all the experiments in which acetamide was the solvent, the cells were surrounded by water at 100°C. A 110 volt direct current was used.

The results obtained will be discussed under the headings of the solvents employed.

Acetamide. Two grams of beryllium sulfate was dissolved in 25 grams of acetamide. After electrolyzing for 25 minutes, the platinum cathode was covered with a black amorphous deposit which proved to be beryllium by the method of detection suggested by Komarovskii and Poluektov.[4] Beryllium was deposited on iron cathodes in the same manner. The deposits became heavier as the current density was increased. At 0.55 ampere, the acetamide became discolored and appeared to decompose.

Monoethanolamine. The electrolysis of solutions of salts in ethanolamine gave interesting results. Beryllium sulfate was fused with an equal amount of ammonium nitrate, and this mixture was dissolved in ethanolamine. Upon electrolysis a dark deposit was obtained on an iron electrode, but this deposit gave no test for beryllium. Likewise, one gram each of aluminum chloride and ammonium nitrate were fused together and dissolved in ethanolamine. The solution was electrolyzed for 20 minutes at 0.25 ampere. When an iron cathode was used, a non-adherent deposit was obtained. It dissolved very readily in dilute hydrochloric acid, but was not metallic aluminum.

Anhydrous aluminum chloride was dissolved in ethanolamine, and the solution was electrolyzed for 23 minutes. A copper cathode was used. After the electrolysis the cathode was partly covered with a metallic deposit which proved to be aluminum. Lead nitrate was dissolved in ethanolamine and after this solution was electrolyzed for five minutes, the copper cathode was covered with a heavy, powdery deposit of lead. A smooth, adherent magnesium deposit was obtained on a copper cathode when a solution of magnesium nitrate in ethanolamine was electrolyzed for 15 minutes at 0.30 ampere. Both stannic chloride and stannous chloride gave a dull, smooth, adherent tin deposit on copper cathodes when dissolved in ethanolamine and electrolyzed for five minutes. In the case of stannous chloride, the cathode was covered with a heavy, powdery, non-adherent tin deposit. This was easily washed off, leaving an adherent deposit of tin on the cathode's surface. Zinc, too, was discharged from ethanolamine. One gram of zinc chloride was dissolved in 20 cc. of ethanolamine and the solution was electrolyzed for 90 seconds at 0.13 ampere. The copper cathode was covered with a powdery, black, non-adherent zinc deposit. This was washed off and underneath it there was a dull, smooth, adherent coating of metallic zinc.

Nitrobenzene. Stannous chloride was dissolved in nitrobenzene and the solution was electrolyzed for 20 minutes, using a copper cathode. The current was 0.02 ampere. The nitrobenzene became dark in color and a slight metallic-looking deposit was formed on the bottom of the cathode. It was rather adherent, dissolved readily in hot, concentrated sulfuric acid, and tests showed it to be a deposit of tin. When stannic chloride was substituted for stannous chloride, no such deposit was obtained. Zinc chloride was similarly dissolved in nitrobenzene and the solution was electrolyzed.

[1] J. Am. Chem. Soc., **52**, 2693 (1930).
[2] Chem. Reviews, **8**, 335 (1931).
[3] J. Phys. Chem., **35**, 2465, 2492, 3111 (1931.
[4] Mikrochemie, **14**, 315 (1934); C. A. **28**, 6387 (1934).

A copper cathode was used. A black, metallic-like deposit of zinc was obtained almost as soon as the current was turned on. This deposit was not easily rubbed off.

Pyridine. Aluminum chloride and chromic acid gave no deposit of the metals when dissolved in this solvent. However, tin was rather easily plated from pyridine. One gram of stannous chloride was dissolved in 20 cc. of pyridine and electrolyzed at 0.20 ampere for 15 minutes, using a copper cathode. The solution turned to a muddy brown color and the current gradually decreased. A dark colored deposit was formed on the cathode. This was washed off with water and underneath was a smooth adherent deposit of tin. Stannic chloride was used in place of the stannous chloride. Here too, the color of the solution became a muddy brown and the current also decreased. The cathode was covered with a very smooth, adherent tin deposit which was very lustrous.

Benzonitrile. A smooth, adherent, dull-metallic colored deposit of tin was obtained on a copper cathode when a solution of stannous chloride in benzonitrile was electrolyzed for six minutes. During this electrolysis, the current rose considerably. One gram of zinc chloride was then dissolved in 20 cc. of benzonitrile and this solution was electrolyzed for five minutes, using a copper cathode. Again, the current rose during electrolysis. The cathode was covered with a smooth, adherent, bluish-gray deposit of zinc.

Benzoyl Chloride. Metallic deposits were not obtained when solutions of beryllium sulfate, magnesium nitrate, manganese chloride, lead nitrate, chromic acid, stannous chloride, zinc chloride and anhydrous aluminum chloride in benzoyl chloride were electrolyzed. Copper cathodes were used. In the case of the aluminum chloride, the solution became dark purple in color, and a yellow waxy substance, resembling vaseline, was deposited on the cathode. When one gram of stannic chloride was dissolved in 20 cc. of benzoyl chloride and electrolyzed for two minutes at 0.03 ampere, the copper cathode received a dark deposit. This deposit was composed of small crystals of tin.

Acetone. One gram of manganese chloride was placed in 20 cc. of acetone, but not all of it dissolved. The solution was electrolyzed for 30 minutes at 0.02 ampere, using a copper cathode. At first a grayish white deposit was formed on the cathode, but when exposed to the air it turned black and was easily rubbed off the cathode. Since manganese readily oxidizes in moist air, the first deposit may have been manganese. The black deposit very readily dissolved in cold dilute hydrochloric acid to give a greenish brown colored solution—the color of aqueous solutions of some manganese salts.

Glacial Acetic Acid. One gram of anhydrous aluminum chloride was dissolved in 20 cc. of glacial acetic acid and electrolyzed for 20 minutes. A copper cathode was used. The current gradually decreased during this run. A small quantity of a white solid was deposited at the cathode, but no aluminum was found there. The deposit was easily washed off with water. One gram of chromic acid was dissolved in 20 cc. of glacial acetic acid. A copper cathode was used and the solution was electrolyzed for 15 minutes. The current at the beginning was 0.08 ampere. After five minutes a pinch of sodium sulfate was added. The amperage slowly rose. No metallic chromium was deposited on the cathode, but the solution showed the presence of a green chromium salt. Next, one gram of stannous chloride was dissolved in 20 cc. of glacial acetic acid and subjected to a current of 0.01 ampere for ten minutes. The copper cathode employed was covered with a slight deposit of tin. However, this deposit of tin was not very adherent. When stannic chloride was used in place of the stannous chloride, no cathodic deposit of tin was obtained.

Phosphorus Oxychloride. One half gram of beryllium sulfate was dissolved in 20 grams of phosphorus oxychloride and subjected to a current of 0.05 ampere for 20 minutes. An iron cathode was used and it received a dark colored deposit which gave a faint test for beryllium.

Summary

In this work, several metals have been successfully electrodeposited from solutions of their salts in nonaqueous solvents.

1. Beryllium was electrodeposited from acetamide, and traces were also deposited from phosphorous oxychloride.
2. Zinc and traces of tin were electrically discharged from nitrobenzene.
3. From pyridine, tin has been electrodeposited.
4. Both tin and zinc were deposited electrolytically from benzonitrile.
5. Traces of tin were also deposited from benzoyl chloride.
6. Manganese was deposited from acetone.
7. Tin was electrodeposited from glacial acetic acid.
8. Ethanolamine seems to give much promise as a solvent from which metals may be deposited electrolytically. Lead, magnesium, tin, zinc and traces of aluminum were electrically discharged from ethanolamine.
9. No deposits were obtained from solutions of manganese salts in aniline, benzoyl chloride, glacial acetic acid and ethanolamine; chromium salts in acetamide, aniline, acetone, pyridine, benzoyl chloride, glacial acetic acid and ethanolamine; lead salts in aniline, benzoyl chloride and glacial acetic acid; magnesium salts in acetamide, nitrobenzene, aniline, acetone, benzoyl chloride and glacial acetic acid; aluminum salts in acetamide, aniline, pyridine, benzoyl chloride and glacial acetic acid; stannous salts in aniline and benzoyl chloride; stannic salts in nitrobenzene, aniline and glacial acetic acid; zinc salts in aniline, benzoyl chloride and glacial acetic acid.

Bright Dips

Q.—I wish a finely etched silver finish on aluminum; also brass dipping mixture.

A.—Aluminum will be etched by caustic soda. During the action the aluminum will be covered with a black smut. This can be removed by dipping in nitric acid, diluted one-half.

For further details on aluminum suggest you get in touch with the Aluminum Co. of America, Pittsburgh, Pa.

For dipping of brass:

Bright Dip:	
Sulphuric acid	1 part by vol.
Nitric acid	1 part by vol.
Water	1 part by vol.

A very small amount of salt can be added to increase the brightness.

Matte Dip:	
Sulphuric acid	1 part by vol.
Nitric acid	1 part by vol.
Zinc oxide or sulphate	to saturation

Operate hot. Keep out water.—G. B. H., Jr.

Trichlorethylene Degreasing—Engineering Aspects

By **WILLIAM B. HARRIS***
Assistant Industrial Hygiene Mechanical Engineer, Division of Industrial Hygiene

The control of trichlorethylene in degreasing operations offers a very interesting and difficult problem in the control of organic vapors. The procedure depends on a delicate balance of the vapor phase of the solvent in a heated metal tank. This balance tends to be upset by any conditions deviating from the ideal.

Whenever metal parts are worked, a more or less dense film of oil always adheres to the surface. Although this is sometimes desirable, it usually is not—as for example when the metal parts are subsequently to be plated or spray painted. For the removal of this grease, trichlorethylene is fast becoming the solvent of choice.

Equipment and Process

The commercial equipment now in use for degreasing metal parts consists briefly, of a metal tank containing the solvent which is heated to the boiling point. A water jacket around the upper portion of the tank cools the hot vapors rising from the boiling liquid, which causes them to condense. The tank thus contains boiling liquid, hot vapors, and a comparatively clean air space above the condenser. The design of this equipment is being continually improved with respect to the amounts of heating and cooling, types of control, dimensions, and operating efficiency, but the essential features remain unchanged.

The degreasing process consists of dipping the parts to be cleaned into the hot liquid for a short period, allowing them to stay in the vapors until they are thoroughly rinsed by condensation, and slowly withdrawing. Thus, in a matter of about two minutes, the dirty parts may be withdrawn clean and dry, immediately ready for further processing.

The outstanding factors disturbing the effectiveness of the control features designed into the machine are: (1) extraneous air currents in the working space, (2) withdrawal of the liquid solvent with the cleaned parts, and (3) improper operation both of the machine, and of the cleaning-out cycle. The heaviest exposure of the operator to vapors occurs during the "cleaning out" of the machine, when the solvent is distilled and the remaining sludge must be raked out.

Although the study which is at present being carried on by the Division of Industrial Hygiene has not been completed, tentative control measures for these factors may be advanced in a preliminary way on the basis of the large experience already available.

The degreasing tank should be so situated in the workroom that a minimum of air movement will be present in its vicinity. There should be no forced ventilation for the workroom as a whole which will have a direct effect upon air velocity in the vicinity of the tank surface.

The heating of the solvent should be controlled thermostatically. When the liquid level is low, or when the boiling liquid is dirty, the heat requirements to maintain the optimum temperatures are altered and there is a tendency to disturb the balance between heating and cooling sufficiently to cause a dissemination of vapors into the work space.

It is desirable to maintain the temperature of the cooling liquid at a sufficiently low level to insure complete condensation of the vapors in the tank and at the same time it must never be less than the dew point temperature of the room. Too low a temperature would cause a condensation of moisture in the tank, increasing the diffusability of the solvent.

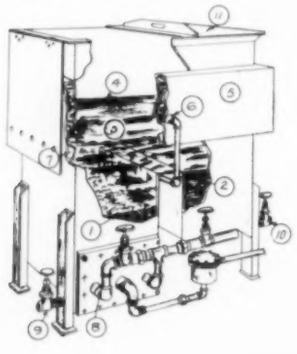
If the machine is gas heated, a positive suction should be placed on the flue to preclude the possibility of a return of gases which have passed through the burner. Furthermore, the machine should be so situated that none of the vapors may come into contact with any open flame.

In the operation of the tank, care should be taken to allow the parts being cleaned to reach the boiling temperature of the solvent before withdrawal. This will insure a more complete evaporation of solvent within the tank. The parts should be lowered into and withdrawn from the tank at a rate not to exceed 12′ per minute, to minimize dragout of the vapors. It is advisable to control the height of the vapor level by means of a thermostat in the tank which will keep the level below about 15″ from the lip of the tank.

If the operator is subjected to an excessive exposure to solvent vapors during the cleanout operation, he should be provided with an organic solvent type respirator which will provide him with protection throughout the entire cleanout.

In general, two factors appear to stand out as primarily responsible for the unnecessary dissemination of trichlorethylene vapors into the air of the workroom in degreasing operations: (1) Excess ventilation and air currents in the room—thereby disturbing the desired dead level of the air immediately over the degreasing tanks; and (2) excess speed in the degreasing operation. A sufficient amount of time must be taken to lower and raise the parts through the vapor without undue displacement of solvent. If production rate does not permit of this, completely enclosed machines which operate with a conveyor and may effectively be exhausted, should be substituted for hand operated machines.

*From The Industrial Bulletin, Department of Labor, New York State, March, 1938.



1. Boiling Solvent
2. Cool Solvent Condensate in Rinse Chamber
3. Dam Separating Boiling and Rinse Chambers
4. Top of Vapor Column
5. Water Jacket Condenser
6. Water Inlet To Cond.
7. Solvent Condensate Collecting Trough
8. Steam Pipes
9. Valve Outlet from Boil Chamb.
10. Valve Outlet from Rinse Chamb.
11. Hinged Cover

Annual Convention of the American Foundrymen's Association

42nd annual meeting held in Cleveland. Registration 5,500. Two sessions and a round table discussion on brasses and bronzes.

By H. M. ST. JOHN
Associate Editor

THE 42nd annual convention and foundry show of the American Foundrymen's Association, held in Cleveland, May 14 to 19, was a conspicuous success. The exhibition of foundry equipment was, by common agreement, one of the best ever held. The technical meetings were largely attended, the papers of high quality, the discussion active and to the point. The total registration of members and guests including local visitors, was in the neighborhood of 9,000.

A new feature of the convention was the first annual address sponsored by the Board of Awards of A.F.A. This address was delivered by *Charles R. Hook*, President, American Rolling Mill Co., Middletown, Ohio, and also President, National Association of Manufacturers. Mr. Hook's subject was "*Some Management Opportunities and Responsibilities.*" In a powerful address, which met with enthusiastic approval from his audience, Mr. Hook emphasized the fact that our present economic system, characterized by private enterprise, is under attack from many quarters and must be actively defended by its supporters if it is to endure. As an extreme example of attacks made upon private enterprise, Mr. Hook cited a bill, introduced in Congress on May 3, 1938 which provides that the Federal government should take over and operate the entire iron and steel industry of the United States.

New Officers and Directors, A.F.A.

At the annual business meeting held on May 18, the following officers and directors were elected:

President—*Marshall Post*, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

Vice president—*Henry S. Washburn*, Plainville Casting Co., Plainville, Connecticut

Directors: *H. S. Hersey*, Cleveland
F. A. Lorenz, Jr., Chicago
D. O. Thomas, South Bend, Ind.
G. A. Seyler, Cincinnati
Hyman Bornstein, Moline, Ill.

The annual dinner was, as always, an outstanding feature of the week. The principal address was by *H. V. Kaltenborn*, news editor of the Columbia Broadcasting System who reviewed both the international situation and the present political situation in the United States.

Seaman Medal to Lorenz

Presentation of the *Joseph S. Seaman Gold Medal* to *Frederick Ayres Lorenz, Jr.* was also made at the annual dinner. This medal, inscribed "for courageously espousing and valiantly bringing to fruition a broad conception of the commercial equation in the foundry industry," was presented by *Joseph L. Wick, Jr.*, Chairman of the A.F.A. Board of Awards. In the absence of Mr. Lorenz, ill at his home in Chicago, the medal was accepted for him by *Alfred Walcher* of that city.

Apprentice Molding Contest

The results of the apprentice contest of the American Foundrymen's Association was as follows:

Pattern Making
First — *John Bloomquist*, John Deere Harvester Works, E. Moline, Ill.
Second—*Edw. A. Menzel*, Brown & Sharpe Mfg. Co., Providence, R. I.
Third—*William Thorp*, Caterpillar Tractor Co., Peoria, Ill.

Non-Ferrous Molding
First — *Joseph Wyban*, Art in Bronze Foundry, Cleveland, O.
Second—*Harry Smith*, Mississippi Foundry Corp., Rock Island, Ill.
Third—*Casimir Kotowicz*, Ampco Metal Corp., Milwaukee, Wis.

New Officers Non-Ferrous Division

At the annual business meeting of the Division the following officers were elected:

Chairman—*Harold J. Roast*, Canadian Bronze Company, Montreal.

Vice-Chairman—*W. J. Laird*, Westinghouse Electric & Mfg. Co., Pittsburgh.

Members of the Advisory Committee:

T. C. Watts, Falcon Bronze Co., Youngstown, Ohio.

R. W. Parsons, Ohio Brass Co., Mansfield, O.

C. V. Nass, Fairbanks Morse Co., Beloit, Wisc.

Technical Sessions

Two technical sessions and a round table luncheon were held by the Non-Ferrous Division. At the first session, under the chairmanship of H. J. Roast, three papers were presented.

"*Heat Treating Zinc Bronze Pressure Castings to Close Up Leakage*" was the title of a paper by *H. F. Fleck* and *T. C. Bunch* of the Pearl Harbor Navy Yard, Honolulu. In the absence of the authors the paper was presented by *T. C. Watts*. The authors report their experiments in "closing up" the minute leaks frequently encountered in producing "gun metal" castings. Results of previous work along these lines is discussed and the usual types of troubles are listed, de-

scribed and remedies proposed. Microscopic porosity is discussed in detail. As the result of a series of experiments, it is stated that an annealing temperature between 1300°F and 1400°F is most effective. The authors conclude that the method is a practical one and that it is well worthwhile to anneal certain classes of castings before preliminary machining and testing. In general, physical properties are improved by such treatment.

A written discussion of this paper was submitted by *J. J. Curran* of the Walworth Company who stressed the thought that, with proper foundry practice, it is perfectly possible to make sound castings which require no heat treatment. *J. W. Bolton* of the Lunkenheimer Company expressed his agreement with this opinion and questioned whether actual healing of microscopic defects would take place by diffiusion.

A. E. Cartwright and *C. C. Brisbois* of the Robert Mitchell Company, Ltd., Montreal, presented a paper entitled "*Risers and Gates for Non-Ferrous Castings.*" The authors have been successful in pouring certain types of castings, both ferrous and non-ferrous, directly through risers. In this manner it has been found possible to avoid many of the difficulties previously encountered. Strainer cores in the pouring risers are also used to advantage. The authors describe in detail some of the various types of castings on which the direct riser pouring method has been used successfully, such as bushings, 85-5-5-5 brass funnel castings, nickel silver castings, pure nickel pump castings, silicon bronze castings. Types of castings with which this method cannot be used are also discussed. Many photographic illustrations are shown.

The above paper brought out a great deal of favorable discussion and some additional information from other sources. Written discussions were submitted by *A. J. Cassista* of the Vermont Foundries, Inc., and *T. J. Wood* of the Robins Conveying Belt Company, Passaic, N. J.

George P. Halliwell of the H. Kramer Company, Chicago, presented a paper on "*Modification of the Saeger Fluidity Test as Applied to Red Brass.*" The modified method consists essentially in permitting metal under a definite head to flow from the bottom of a preheated crucible into the fluidity spiral. The author feels that the method is an improvement over that of *Saeger* and *Krynitsky*, since the personal equation involved in pouring has been reduced to a minimum, the temperature drop from pouring a crucible to spiral is probably less than in other methods and the sensitivity of the test is increased. Complete data and illustrations are given.

H. M. St. John of the Detroit Lubricator Company presided as chairman of the second session, with *R. W. Dayton* of Battelle Memorial Institute as vice-chairman. Three papers were presented.

H. J. Roast
Chairman of a Technical Session

In the absence of the author, *Dr. Lorig* of Battelle Memorial Institute presented a paper entitled "*The Role of Silicon in Non-Ferrous Castings*" by *H. W. Gillett*, also of Battelle Memorial Institute. The author discusses the use of silicon in magnesium-base, aluminum-base, copper-base and nickel-base alloys, including trade names, compositions, properties, foundry behavior and heat treatment of a large number of alloys. Precipitation hardening of certain alloys is discussed at some length. The effects of tin, zinc, manganese and iron on the copper-silicon alloys are explained. With respect to the latter, *Dr. Gillett* mentions that foundry practice is difficult and the alloys very sensitive to a number of factors, such as the presence of small percentages of lead. He closes by saying: "However, you cannot keep a cheap alloy down when it has the potentialities possessed by the copper-silicon family. Foundry metallurgists are ingenious animals, who have solved equally tough problems. Some day they will work out the kinks of this problem and develop alloys and methods that utilize the known advantages and avoid the disadvantages conferred by silicon." A written discussion was submitted by *M. G. Corson.*

The subject of precipitation hardening was reviewed by *L. W. Kempf* of the Aluminum Company of America, Cleveland, in a paper entitled "*A Description of the Age Hardening Process as Applied to Castings.*" The fundamentals of this process are described in simple terms, with diagrams and photomicrographs. Properly chosen alloys of various base metals can be cast in a soft, machinable condition and later greatly hardened and strengthened by a solution heat treatment followed by a precipitation treatment at a lower temperature. Thus one of the inherent advantages of steel over the non-ferrous alloys has been largely eliminated. While much commercial use of this method is being made, particularly with the light alloys, a lack of appreciation of its possibilities is retarding its application to the copper-base alloys.

This subject was further developed in a paper entitled "*Production and Properties of Age-Hardenable 5% Nickel Bronze Castings*" by *T. E. Kihlgren* of the International Nickel Company, Bayonne, N. J. If the conventional 88 copper, 10 tin, 2 zinc bronze is modified by substituting 5% nickel for half of the tin, the "as cast" alloy is found to have a tensile strength of 48,500 psi., a yield point of 24,400 psi., an elongation of 42% and a Brinell hardness (1000 Kg load) of 86. If this metal is then annealed at 1400°F, followed by a precipitation heat treatment at 550°F, the average properties obtained are: Tensile strength—87,000 psi., yield point—70,000 psi., proportional limit —50,000 psi., elongation — 10% Brinell hardness—195. Lead is a highly objectionable impurity and as little as .05% will seriously retard age hardening and also cause hot cracking if the castings are rapidly cooled from the 1400°F "solution treatment." Silicon retards aging but the effect of small amounts of silicon (.05-.10%) can be neutralized to a

considerable extent by a moderate increase in the aging temperature and in the nickel content (to 5.5%). The effects of other impurities are briefly discussed. The foundry procedure recommended for castings to be age hardened differs from that considered good practice in 88-10-2 bronze chiefly in the oxidation of the copper-nickel melt with cuprous oxide (or other suitable oxides) and a subsequent reduction with phosphorus, prior to the addition of remelt and the introduction of tin and zinc.

In discussion, *George Halliwell* of the H. Kramer Company, Chicago stated that he had not found small percentages of lead to be quite so objectionable as indicated by the author. Although lead unquestionably interfered with age hardening for the attainment of maximum physical properties, fractional percentages of this impurity could be tolerated with reasonably good results.

Crucible Discussion

At the non-ferrous round table luncheon meeting the discussion was opened by a talk on *"What's New in Crucible Furnaces"* by *Richard H. Stone* of the Vesuvious Crucible Co. This talk dealt with insulation, fuel costs for gas, oil and coke and the so-called sealed crucible. Tilting furnaces have been greatly improved in ease of operation, efficiency and applicability. They are used in the larger sizes from 375 to 1500 lb. capacity. Lift-out furnaces are commonly employed in installations where many small similar castings are made.

Following some comments on Mr. Stone's talk, the Round Table, under the chairmanship of *H. J. Rowe*, Aluminum Co. of America, Cleveland, proceeded to a general discussion of casting defects and foundry practice which lasted for several hours.

Brass and Tin Solutions

Q.—I am running a cold barrel brass (120 gallons) which is replenished every fortnight approximately with the following solution:—

Basic copper carbonate	6½ lbs.
Zinc sulphate	2½ lbs.
Potassium cyanide	18 lbs.
Arsenic brightener	1 fluid oz.
Water	up to 8 gals. approx.

The arsenic brightener is a saturated solution of arsenious oxide in potassium cyanide. This gives satisfactory results over a period of about a week, when a further cyanide addition is usually necessary in order to restore the required color which is a lightish yellow brass. Each load of articles is given about 60-75 mins.

When the solution is working satisfactorily it has been noticed that:— 1. Free cyanide (determined by nickel sulphate) is 1½ oz./gal. 2. pH is 11.3.

The only complaint I have to make about the solution is one connected with changing color. I am being frequently reminded that "Other brass is far better than ours as far as color is concerned, and others work them hot, boiling hot, why can't you do the same?" To which the usual reply has been that if the solution is worked hot the tendency to change color will be even greater and that it would be safer for us to continue using the cold solution.

I have also been recommended to use a solution composed of zinc and copper cyanides but have rejected this on the same grounds as given for the hot solution.

Now, will you tell me

1. Is this hot solution satisfactory?
2. Is a cyanide formula to be preferred to the carbonate-sulphate one?
3. Is our copper-zinc ratio correct?
4. Are free cyanide and pH alright?
5. Can you recommend a more suitable formula?

One more query. Can you give me a formula for *cold* barrel tin? I have tried the following:—

American brown potash	10 lbs.
Stannous chloride	3¾ lbs.
Glue	½ oz.
Water to make	10 gals.
Voltage	3
Temp.	16°C.
Speed of barrel	30 r.p.m.

This has had no success, a greyish non-adherent coating being produced.

A.—Brass plating for color, while not difficult, does necessitate a certain amount of constant control. This is especially true when solutions of small volume are operated.

A solution of the following composition will produce brass deposits of good color when properly controlled:

Copper cyanide	3.6 ozs.
Zinc cyanide	1.2 ozs.
Sodium cyanide	7.5 ozs.
Sodium carbonate	4.0 ozs.
Water	1 gal.

Temperature: 75 to 110 deg. F., current density 3-5 amperes sq. ft.; voltage 2-3 volts; free cyanide 2.5 oz./gal., anodes 80% copper and 20% zinc. The addition of 1 pint of ammonia to each 100 gals. of solution will help in producing a deposit of good color when starting a new solution. In the operation of the bath it is necessary to maintain the metal content as near given limits as possible, free cyanide content and the pH of the solution. The solution can be operated at normal temperature but would suggest an operating temperature around 100 to 105 deg. F. for best results.

The pH of the solution it has been found will greatly effect the color of deposit if allowed to vary greatly. As the composition and concentration of the various elements in a brass solution will effect the pH, it is rather difficult to say definitely just what pH will work the best. A little experience will probably be a great help in deciding at just what pH the solution will produce the uniform color desired. A pH of 12.2 in a warm solution will produce a uniform color, however, it should not go above this value.

A tin solution made up as follows should operate satisfactorily and produce a fairly bright finish:

Sodium stannate	12 ozs.
Sodium acetate	2 ozs.
Powdered rosin	1½ ozs.
Water	1 gal.

Temperature 130 deg. F., anodes pure tin; voltage for barrel work 10-12 volts. It is advisable to add small amounts of 100 volume hydrogen peroxide daily to oxidize stannite salts formed back to stannate condition. If an extremely bright finish is desired, this can be accomplished by rolling in a neutral soap solution for not more than 10 minutes. After rolling in soap solution, rinse in cold water, then roll in clean, cold, hardwood sawdust.—

T. H. C.

Shop Problems CASTING • METALLURGICAL FABRICATION • ASSEMBLING • • PLATING • FINISHING

Questions from readers relating to shop practice and answers by our associate editors

Finishing Lamp Finial

Q.—I am sending to you under separate cover a finial in a finish that we would like to make, and I will appreciate it if you will kindly advise me in detail how we can duplicate this finish.

A.—The following solutions can be used in coloring the part submitted:

Coloring:	
Antimony sulphide	2 ozs.
Sodium hydroxide	4 ozs.
Ammonia	¼ oz.
	Use at 160 deg. F.
Water to make	1 gal.
Setting:	
Copper sulphate	4 ozs.
Water to make	1 gal.

The following steps are used:

1. Light bright dip.
2. Rinse.
3. Color.
4. Rinse.
5. Set.
6. Rinse.
7. Repeat if necessary.
8. Scratch brush wet.
9. Dry.
10. Lacquer.

—G. B. H., Jr., Problem 5,658.

Grinding Knife Blades

Q.—We are making out of cold rolled steel, (carbon .70-.80, manganese .50-.80) cutlery knife blades, which we harden and temper to Rockwell C-56-58.

We desire information on *economical* grinding, polishing and buffing these blades to a good mirror finish. Could you furnish us with such information as, to abrasive size and kind, sequence of operations, cutting speeds, etc.

A.—Some information on this subject is contained in the 1937 issue of the Platers' Guidebook (METAL INDUSTRY) on pages 6 to 11.

The methods suggested probably do not differ in any radical way from those in common use. The faster cutting artificial abrasives are used. Special machines are used for glazing.

A typical procedure is, grind with No. 60 grit then No. 100 alumina wet with water on a machine, or by hand on a wheel such as a 40" x 3" wheel at 300 rpm. Then, glaze on set up wheels using 120 grit and about 7,000 peripheral ft./min. Buffing can be done on a felt wheel. Exact procedures will differ in various shops.

—G. B. H., Jr., Problem 5,659.

Nickel Throwing Power

Our nickel plating bath is not giving the results it should. It has gotten so that it throws very poorly. We plate using approx. 2 volts. The nickel

Use this Blank for Solution Analysis Information

Fill in all items if possible.

Date .....

Name ..... Class of work being plated: .....
Address ..... City ..... State ..... Volume used: .....
Employed by: ..... Solution depth: .....
Kind of solution: ..... Cathode surface, sq. ft.: .....
Tank length: ..... width: ..... Kind of anodes: .....
Anode surface, sq. ft.: ..... Distance from cathode ..... Original formula of solution: .....
REMARKS: Describe trouble completely. Give cleaning methods employed. Send small sample of work showing defect if possible.

Use separate sheet if necessary.

NOTE: Before taking sample of solution, bring it to proper operating level with water; stir thoroughly; take sample in 2 or 3 oz. clean bottle; label bottle with name of solution and name of sender. PACK IT PROPERLY and mail to METAL INDUSTRY, 116 John Street, New York City.

plate does not give any trouble with respect to cracking or peeling. However, it just will not throw into recesses.

Will you please analyze this solution, and tell us what it needs?

A.—The composition of the sample submitted is:

Nickel	5.0 ozs./gal.
Chloride as amm. chloride	.9 ozs./gal.
pH	below 5.2

If this is being run as a high pH room temperature solution, the metal is too high and the pH too low.

Kindly advise what type of solution this is, giving the original conditions if possible. For example is this a low pH solution and is it run at above room temperature?

If this solution is being run as a plain room temperature solution, high pH, the following changes are recommended.

To reduce the high metal content remove about ¼ of the solution and add water. Then add 2¾ ozs./gal. of ammonium chloride and 2 ozs./gal. of boric acid. The pH should then be brought up to 5.8 by adding ammonia. Submit another sample after making above changes for check on pH and approximate amount of ammonia to add will be given. Operation of present solution would improve with respect to throwing power by adding ammonia but with high metal content you may obtain a brittle or pitted deposit. —G. B. H., Jr., Problem 5,600.

Plating Die Castings

Q.—We are now manufacturing an item which has a zinc alloy base. We are interested in finding out whether or not it is necessary for this metal to have as a base for chrome plating the element of copper or whether just *nickel and chrome* without copper is more satisfactory.

A.—The direct nickel plating of die castings requires careful manipulation and control of the solution. A solution that can be used to direct nickel plate on die casting can be made from:

Single nickel salts	10 ozs.
Sodium sulphate crystals	9 to 16 ozs.
Ammonium chloride	2 ozs.
Boric acid	2 ozs.
pH	5.8 to 6.0

In plating castings with deep recesses trouble will be had with throwing the nickel into the recesses. They will get dark due to zinc being displayed by nickel.

In order to overcome the above difficulties it is common practice to first give the zinc article a coating of copper from a cyanide copper solution. The copper should be at least .0003″ thick, to have a good job. Thinner coatings will be gradually absorbed by the zinc and peeling of the finish will result.

After the cyanide copper, nickel plate and chromium plate.

—G. B. H., Jr., Problem 5,661.

Rough Nickel Deposit

Q.—Under separate cover, I mailed to you today, sample of my nickel plating solution, which is plating rough as you will see by sample; also dark on the top parts of articles and a few dark streaks on some pieces also. Have had no trouble with any work going through the chrome, as to peeling; some pieces are quite alright providing they are not plated too long.

A.—Roughness can be caused from excessive iron in the solution which in turn comes from the use of high iron content nickel anodes. If excessive iron is present it can be removed by treating the solution with peroxide and ferrous sulphate and filtering. Details of this procedure will be furnished if requested.

Roughness can also be caused by metallic particles released from the anode due to poor anode corrosion. The anodes, if of the high purity type, should be bagged with a good grade bag. The type of corrosion obtained from the anode will also depend on maintaining the proper chloride content in the solution. The chloride content can be 4 ozs./gal. with high purity anodes.

Composition of your solution is:

Nickel	3.4 ozs./gal.
Chloride as amm. chloride	2.5 ozs./gal.
pH	5.7

The chloride can be increased as stated above.

The best remedy at the moment for you to follow is to filter the solution. Suggest you have the solution checked for other impurities beside iron, such as zinc and copper. Some relief can be had from roughness by the use of a wetting agent which will prevent to some extent the adherence of floating particles on the work.

—G. B. H., Jr., Problem 5,662.

Well Water for Cadmium Plating

Q.—I have a question to ask on advisability of using well water in plating operations for cadmium plating steel radio chassis.

A.—The final answer on the suitability of any particular water for plating purposes would come after all sources of possible trouble were checked over and this is not easily done without actual inspection of the methods in use. An analysis of the water for chlorination, and calcium and other salts would give an idea of the desirability of the water. A simple test is the hardness test, in which the amount of soap required to produce a lather is determined. A good water will produce a lather with only a small amount of soap. A hard water would require a great deal of soap before producing a lather, due to the fact that the first portions of soap would be precipitated as insoluble metal (calcium and magnesium) soaps which appear as a curdy or milky suspension. This type of water will give trouble in the cleaner and in rinsing as the insoluble soaps will produce films that cannot be rinsed or pickled off and which will cause trouble in plating.

An acid pickle should not be counted on to remove the film left by a cleaner. The primary purpose of the acid dip is to etch the metal and remove any oxide film. If an alkaline film is on the work before going into the acid you will get a neutralization, but you will be running into the possibility that the product formed will be a film itself. Thus a slight amount of soap film on the work will be neutralized by the acid dip, but the resulting product will be an acid soap which is a very insoluble material that will not rinse off and will cause peeling and other troubles.

The time of plating for a radio chassis will depend on the type of job required by the customer. It is usual practice to put on a coating .0002″ thick for ordinary resistance to indoor conditions. At 10 amperes per square foot from 15 to 20 minutes will be required to deposit this thickness.

—G. B. H., Jr., Problem 5,663.

Metal Casting Digest

Short abstracts of articles of interest to practical non-ferrous foundrymen and metallurgists

By H. M. ST. JOHN
Associate Editor

Plastics and the Metal Industry. Herbert R. Simonds. Iron Age, Sept. 16th, 1937, page 40.

"Do plastics threaten metals as a construction material?" The author's opinion is: "Either the metal fabricators must take over plastics and adapt them to their use or the plastics fabricators will take over metals." The paper discusses the injection moulding of plastics over metal and mentions also the dipping process.

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Bearing Metal in the Transport Industry. H. N. Bassett. Chemistry & Industry, 1937, page 11; Chemical Abstracts, Sept. 20th, 1937, col. 6590.

In linings more than 1/16 in. thick, bearing metals having hard grains and a soft matrix act best, while in thin linings pure tin or lead is preferable. In transport conditions alloys are always used, either white metals or, for heavy loads, copper alloys. Suitable alloys for various purposes are described. Cracking of white-metal linings, particularly in Diesel engines, is mainly due to bad adhesion. In such bearings copper-lead alloys are now often used.

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Chilling and Inverse Chilling. Ichiro Iitaka and Takeshi Tanaka. Bull. Inst. Phys.—Chem. Research, Vol. 16, page 99; Chem. Abstracts, Sept. 20th, 1937, col. 6592.

A section of ingot cast into metal and sand mold was roughly polished and Shore hardness was determined along concentric rings. Generally hardness increased gradually on approaching to the periphery of ingot; a chilled layer or skin effect was not, however, observed except cast iron poured into a metal mold. Hardness of brass and bronze increased at first with the distance from the center to a maximum and then decreased toward the periphery. This phenomenon of "inverse chilling" can be ascribed neither to the inhomogeneity of chemical composition nor to the effect of heat treatment.

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Deoxidation of Nickel and Nickel-Copper Alloys. H. Nishimura, M. Morinaga and T. Ikeda. Suiyokwai-Shi, Vol. 9, page 251 (1937); Chem. Abstracts, Sept. 20th, 1937, col. 6599.

If molten nickel and nickel-copper alloys absorb oxygen, their fluidity is much decreased; hence they must be always deoxidized with magnesium to be cast. The poor fluidity of nickel-copper alloys which absorbed oxygen was ascribed to the primary separation of unknown oxide (probably a double oxide between Cu_2O and NiO). Industrial nickel-copper alloys such as monel metal and cupro-nickel contained about 0.02% of oxygen and even if magnesium was added as a deoxidizer, the oxygen of this order was found always to remain in the alloys.

Admixtures in Silicon Bronzes and Brasses. A. P. Smiryagin. Tsvetnye Metal, 1936, No. 6, page 101; Chem. Abstracts, Sept. 20th, 1937, col. 6600.

The author studied the influence of various elements on the microstructure, physical, mechanical and casting properties of copper-silicon alloys. The results showed that greatest plasticity is attained in alloys containing 3 to 3.5% silicon, and greatest strength in alloys with 5 to 5.5% silicon. The effect of various elements is summarized as follows: Iron lowers the corrosion resistance, antifriction and mechanical properties and, therefore, is undesirable. Tin increases the hardness and decreases ductility and impact strength of the alloys, especially of brasses; the tin content should be limited to below 1%. Antimony and arsenic are harmful because they lower the strength and toughness, cause the formation of eutectic veins in the interdendritic spaces, and of intercrystalline pores and fissures. Castings lose their soundness and often fail under hydrostatic test. Phosphorus in amounts exceeding 0.5% decreases toughness because of the formation of low-melting and brittle eutectic and beta-crystals. Nickel, unless the castings are artificially aged, is also an injurious element as it decreases the impact resistance and ductility and increases the hardness. This shows that the effect of nickel on silicon bronzes is opposite to that which it exerts on tin bronzes and ordinary brasses. Aluminum improves the mechanical properties and corrosion resistance of silicon bronzes and brasses, but in small quantities causes the formation of Al_2O_3 films which lower the quality of the alloys, and therefore should be avoided. Lead improved considerably the antifriction properties of the alloys; mechanical properties of silicon bronzes are, however, impaired, but still are better than those of tin bronzes. Lead in amounts above 3% causes the formation of films, pores and intercrystalline fissures. The presence of the above metals in the silicon bronzes and brasses in combinations of two or more is injurious because it tends to increase shrinkage, films, pores and impair the mechanical properties. Particularly in the manufacture of steam- and water-line castings from silicon brasses and bronzes (made by adding ferro-silicon and sand casting) it is necessary to avoid the following combinations: (1) Lead in bronzes with low silicon content, (2) Aluminum in presence of lead, (3) Aluminum in presence of tin, (4) Aluminum, lead and tin in all cases.

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Oxidation of Beryllium Bronzes. Haldun N. Terem. Compt. rend. Vol. 205, page 47 (1937); Chem. Abstracts, Sept. 20th, 1937, col. 6600.

The oxidation of copper-beryllium alloys was determined by Guichard's method. Results (shown by curves) indicate that the alloy containing 2% beryllium is almost nonoxidizable. At 610°C it is only ¼ as oxidizable as steel containing 12.5% chromium. Further increase in the amount of beryllium slightly increases the oxidizability.

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White Metals and Bronze Bearings from the Manufacturer's Point of View. M. Melhuish. Proc. Inst. Auto Engrs., Vol. 30, page 431; Chem. Abstracts, Sept. 20th, 1937, col. 6600.

The manufacturer of tin- and lead-base white metals and the influence of impurities, e.g., iron, zinc and bismuth, and of methods of alloying on their properties are discussed. The various methods of lining with white metals are compared.

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Moulding a Marine Propeller with Hollow Blades. T. R. Harris Metal Ind. (London), Sept. 3rd, 1937, page 225.

Describes a novel method of moulding and coring to meet the requirements imposed by very thin sections.

• • •

Metallurgy and the Aero Engine. D. R. Pye. Metal Ind. (London), Sept 10, 1937, page 249.

The Sixteenth Autumn Lecture before the Institute of Metals (British) which describes among other things, improvements in casting materials.

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Production of Preessure Tight Castings in 30 percent Cupro-Nickel. T. E. Kihlgren. Trans. Amer. Foundrymen's Assoc., Oct. 1937, page 225.

The author recommends melting under slightly oxidizing conditions, followed by oxidation of the melt and subsequent deoxidation. Silicon and manganese additions are made 3 to 5 minutes before pouring (0.80 to 1.0% manganese, 0.20 to 0.30% silicon, under normal conditions, as much as 0.50% silicon when higher physical properties are required). If sulphur pick up is probable, 0.025% magnesium is added just before pouring. The presence of manganese neutralizes the sluggishness due to silicon. Lead is a decidedly dangerous impurity in silicon content cupro-nickel causing leakers and hot cracking, and should be virtually absent. The effect of other elements such as zinc, tin, iron, etc. on the castability and physical properties is developed briefly in the paper. The method of feeding the castings as well as the pouring temperature has a marked effect on the quality of castings.

Modern Production Equipment

New processes, machinery and supplies for metal products manufacturing and metal finishing

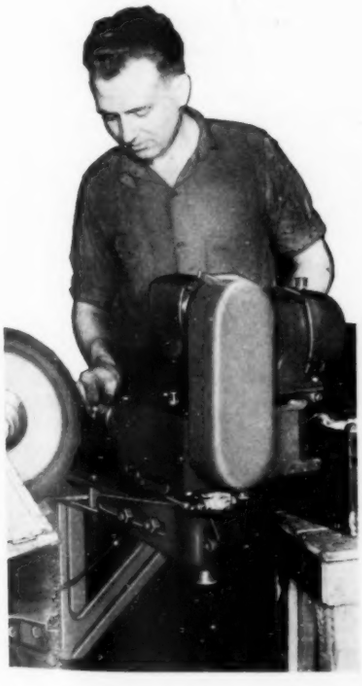
Automatic Buffing Machine

Announcement of a new automatic buffing machine by the Shakespeare Products Co., Kalamazoo, Michigan was made recently by Henry Shakespeare, vice president in charge of manufacturing. Chief among the claims made for the new machine is that the work is taken straight into the buffing wheel with equal pressure on all critical surfaces instead of "sliding over" it as on dial machines and that this exclusive feature enables contour buffing of soft metals and plastic materials as well as hard buffing of steel and brass parts.

The machine was developed to fill a long needed place in the Shakespeare Company's own buffing room and has been is use in the Shakespeare plant on a three shift basis for a year.

Its economy lies in the fact that a large number of parts can be handled with one investment—without the necessity of an additional outlay for tooling.

The machine, it is stated, requires only 15 minutes or less set up time. Many salvage and small runs formerly uneconomical even to hand buff can now be automatically machine buffed on a profitable basis.



Shakespeare automatic buffing machine

Single End Polisher

The Hammond Machinery Builders, Kalamazoo, Michigan announce a new Rite-Speed polishing and buffing equipment. It is a heavy duty single end machine designed for heavy bulky work and for one operator per machine. The chrome nickel spindle

Hammond heavy duty single end polisher

runs in three ball bearings and the machine is equipped with—

a—combination switch and brake enabling the operator to shut off motor and stop the revolving spindle instantly.

b—spindle lock which holds spindle securely when changing wheels.

c—automatic motor starter with overload and low voltage protection.

d—motor in base up to 10 H.P. capacity with multi-"V" belt drive.

Automobile Polish

The Macar process is the latest development of the McAleer Manufacturing Co., 2431 Scotten Ave., Detroit, Mich. This process, it is stated, combines the properties of polish, a cleaner and a wax, in order to enable the car owner or garage man to clean, polish and protect his car finish in one simple operation. It is recommended not only for automobiles but for furniture and any other lacquered, varnished or enameled surfaces.

Full directions are supplied with the materials.

Latest Products

Each month the new products or services announced by companies in the metal and finishing equipment, supply and allied lines will be given brief mention here. More extended notices may appear later on any or all of these. In the meantime, complete data can be obtained from the companies mentioned.

Automatic Shut-Off Valve; placed in the supply line above flexible hose for air, steam, gas, etc. D. J. Murray Mfg. Company, Wausau, Wisc.

Mixers for Cutting Oils. High speed units consisting of tanks with paddle type agitators. Mixing Equipment Co., Rochester, N. Y.

Air Hose for Compressor Service; with oil-proof inner tube. Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.

Oil Proof Wipers for Machine Shop Equipment. Paranite synthetic rubber. Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.

Multiple Oil and Water Extractors; for compressed air lines. Binks Mfg. Co., 3114 Carroll Ave., Chicago, Ill.

Twin Paint and Air Hose. "Siameez Web," for spray painting. Binks Mfg. Co., 3114 Carroll Ave., Chicago, Ill.

Yumidol. A special grade of sorbitol. A straw colored viscous liquid with higher specific gravity, viscosity and refractive index than glycerin. Glyco Products Co., Inc., 148 Lafayette St., New York City.

Heavy Duty Wet Grinders; made in four sizes. Hisey-Wolf Machine Co., Cincinnati, Ohio.

Acoustic Phone Booths for Factories; suitable for noisy locations. Acoustic Division of Burgess Battery Company, Chicago, Ill.

Endless Flow Process for Frit Manufacture; for porcelain enameling frit. Ferro Enamel Corp., 4150 E. 56th St., Cleveland, Ohio.

Air Cleaner for Grinding, Welding and Other Applications. Lincoln Electric Co., Cleveland, Ohio.

Mercury Plunger Relay; A.C. relay or a cross-the-line starter. H-B Electric Co. Inc., 2518 N. Broad St., Philadelphia, Pa.

Plymetl Pattern Board or Match Plate; lighter and cheaper than metal. Haskelite Mfg. Corp., 208 W. Washington St., Chicago, Ill.

350-*Ton Capacity Hydro-Dynamic Single-Action Press*. E. W. Bliss Co., 1420 Hastings St., Toledo, Ohio.

Special Ammonia Bottle "Pour-clean"; one-piece plastic screw closure; patented pouring lip, etc. Merck & Co. Inc., 161—6th Ave., New York.

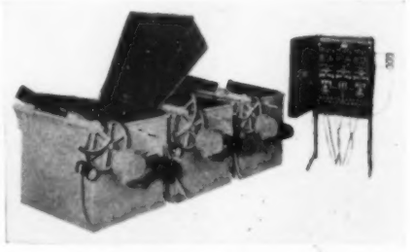
Hopper-Type Barrel Plating Equipment

Automatic handling of barrel plating work has been made commercially practical by the use of simple, inexpensive hopper equipment designed by the Hanson-Van Winkle-Munning Company, Matawan, N. J., manufacturers of electroplating equipment and supplies. The purpose of this type of operation is lower production cost; proper control of treatments; large production capacity in small floor space; low maintenance cost; segregation of various classes or small batches of work without confusion; in general, improved and more effective treatment of work than is possible with dipping baskets.

An interesting installation of this type is in operation at the plant of a New England manufacturer. The work which has previously been ball rolled or sand rolled is dropped into the hopper of the first tank and receives a cold water rinse. It then proceeds from one hopper to another, through a cleaner, a cold water rinse, an acid dip, another cold water rinse, and then to an empty plating barrel cylinder. After being plated for the required time, the work goes again from one hopper to another, through a cold rinse, then a hot rinse and finally into Mercil type centrifugal drier, where all the moisture is removed. From the drier the work is dropped into a suitable handling receptacle and travels through the plant for further operations.

The lifting of the hoppers for dumping can be effected by hand or by electric hoist, like the handling of the plating barrel cylinders. The operator follows a regular routine for normal loads and speeds, handling all the loads in rotation. He places the plating barrel cylinders in the proper location in tanks, moving them ahead as production requires and dumps them into the hopper to remove the work for final cleaning and rinsing operations preparatory to drying.

Several different designs of hoppers are in use in different locations, depending upon the size of the articles and the shape of the bottom best suited for rinsing and treatment of the work. The hoppers are made in either plain steel or Monel metal. The tanks are plain steel or rubber lined, with bottom drain outlets and substantial overflow dams. Each hopper load is equivalent to the plating cylinder load, which varies from 50 to 150 lbs. Adequate rinsing is assured by proper circulation of the liquid through the overflow dam, but for work requiring special treatment, a simple reciprocating device is added which will continuously swish the hopper through a vertical stroke of about six inches.

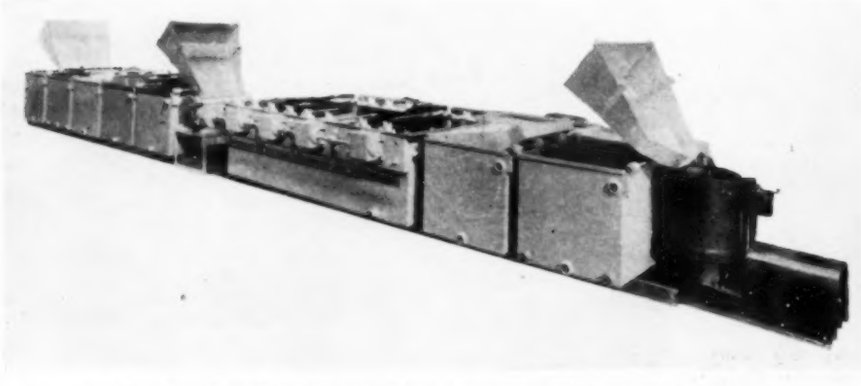


Three rinse tank units showing driving mechanism. Any number of these units can be set in and controlled from the instrument panel shown on the right

Where loads are heavy and the rate of operation is high, automatic lifting and lowering of loads is more productive than manual hoist operation. It has been found practical to adapt the standard Mercil type motor drive, as used in the original Hanson-Van Winkle-Munning plating barrel apparatus, to operate these hoppers. This drive consists of a one-quarter horse power motor, direct connected to a worm gear reducer with a rubber cushion coupling. On the end of the slow speed reducer shaft, a steel pinion drives a large gear which, in turn, operates a quadrant gear firmly keyed to the hopper shaft. A limit switch (shown in the illustration at one end of the tank directly in front of the large gear) offers a positive control for raising and lowering the hopper as it is geared directly to the driving unit. Time required, about thirty seconds.

Each tank has an individual motor drive and limit switch, thus permitting the addition of as many hopper units as required, depending upon the number of treatments involved, and also controlling the entire assembly automatically from a master panel board. The control board is equipped with dials to give selected "dwells" (immersion of the hopper load in the solution) from twenty seconds to four minutes per tank. Added safety features are start and stop push buttons and a system of synchronizing all the drives to maintain regularly in the flow of work from tank to tank, all properly timed.

The work load varies from 50 to 150 pounds. Assuming a treatment of 1½ minutes dwell in each tank and 30 seconds for raising and lowering the hopper, the production flow would equal thirty hopper loads per hour. With an average of 75 pounds per hopper, the production would be 2.250 pounds per hour. It is possible to handle all operations, including that of the plating barrels, with a crew of two men, giving a very low labor cost together with perfect timing in all the treatments and rinses, and assuring a first-rate plating job.



A complete barrel plating assembly; rinse tanks, plating tank and Mercil type centrifugal dryer

Test Papers

A new type of test paper with a wide range, called Hydrion, is announced by R. P. Cargille, distributor, 118 Liberty St., New York. These papers are recommended for the rapid determination of approximate pH, showing the following color changes:

pH-2—very strongly acid—red
pH-4—strongly acid—orange
pH-6—weakly acid—yellow
pH-8—weakly alkaline—green
pH-10—strongly alkaline—blue

It is stated that these papers can be used with turbid and highly colored solutions by observing the color of outer diffusion zone on spot tests.

Finishing Material

A new enamel for industrial finishing is announced by the du Pont Company. Known as Short-Bake "Dulux," this new finish greatly speeds up production. Its shorter baking time (8 to 10 minutes at 350°) allows a greater output with smaller ovens. Du Pont laboratories have worked for three years in research on the new product.

In addition to its shorter baking time, the new finishing material is said to have demonstrated satisfactory adhesion to metal and good hiding in one coat. It may be applied on solvent cleaned steel, bonderited steel or primed steel. It shows hardness, mar resistance, flexibility and high resistance to grease, soap and alkali. White or colors are available.

X-Ray Tube and Powder Spectrum Camera

The new Aminco Ion Type X-Ray Tube described as a reliable steady, and powerful source of homogeneous (monochromatic) or heterogeneous (white) x-radiation for diffraction and crystal structure study, metallurgy, and chemical x-ray analysis is announced by the American Instrument Company, Silver Spring, Maryland.

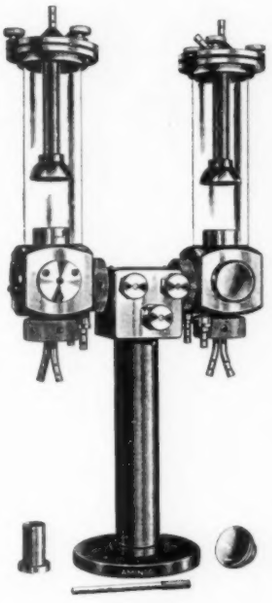
A new powder spectrum camera for use with the new tube is also announced.

This tube was developed at the Geophysical Laboratory of the Carnegie Institution of Washington and is available in single and double-tube units, each tube being provided with three windows, thus three or six radiographs are obtainable independently or simultaneously with the single or double-tube units respectively.

Each tube can be operated independently in the vertical or horizontal position and at any angle. In the double-tube unit, one tube may be operated while the other tube is inoperative or demounted.

Tubes are demountable for operation independently or simultaneously, and two radiations may be obtained simultaneously by using different targets in each tube.

Other features include: (1) no leakage or corrosion due to the use of stainless steel bodies and pyrex glass cylinders; (2) unique vacuum seals and valve construction; (3) contamination of the target is impossible; (4) targets interchanged easily; (5) cathodes are replaced easily; (6) regulation of gas pressure accomplished conveniently and precisely; (7) will operate continuously with heavy output for days without pumping or attention; (8) simple and efficient water cooling system.



Aminco ion-type X-ray tube

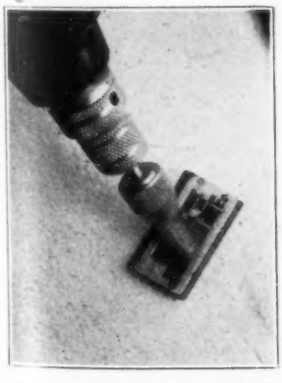
Fully described in manufacturers' Bulletin 1045MI, which will be sent on request.

Grinding and Polishing Kit

A novel, easy to change chuck mandrel uses three different types of accessories for grinding and polishing. The makers claim the new device to be especially valuable to tool and die makers. The chuck mandrel can be used over and over again. Once it is mounted in a portable tool or flexible shaft it need not be removed; just unscrew the chuck nut and change the accessory. Made by the Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Chicago, Ill.

One of the accessories included in this "Handee Kit" is a conveniently shaped abrasive point. Designed to special grade and grain standards it can be used for most grinding purposes on all types of metals.

A special rubber tip conical in shape makes it easy to reach hard-to-get-at places and removes much of the hard drudgery in finishing tools, dies, jigs, fixtures and etc. The grinding action removes scratches and marks. The five different types of polishing compounds in the rubber tip give a mirror finish without the use of additional accessories. For those who wish a higher finish the Kit includes a special shaped felt cone which can be loaded with a variety of compounds.



Chicago chuck type mandrel

Abrasives

The M. P. Iding Disc Grinding Compound Company Inc., of Milwaukee, Wisconsin, recently concluded extensive research with abrasives in conjunction with one of the largest manufacturers of abrasive, for use with their original polishing cements. As a result, they are now announcing sales of their new product, manufactured exclusively for them. For any need or job they have ready for sale a specially prepared aluminum oxide abrasive as well as a silicon carbide abrasive.

"Idilite," their aluminum oxide abrasive is manufactured in two types: (1) the ET type or etched grains possessing very high capillarity and extraordinary sharp-cutting qualities; (2) the NT type or non-etched grains possessing long-wearing qualities and producing much brighter finishes when used with cements.

"Idilon," their silicon carbide abrasive, finds special use for polishing grey iron of all kinds.

The Iding Co. is now prepared to furnish these grains in any size or type from pound lots to carloads.

High Frequency Current Exhibit

Among the recent exhibits opened to the public at the Franklin Institute, Philadelphia, Pa., is one showing the heating effect of induced high frequency currents. All parts of the equipment for generating the high frequency current are visibly arranged in a glass case, enabling one interested to trace the circuits and, as he pushes a button, to see just what happens during the heating cycle.

A note on the exhibit states that induction furnaces of 8 tons capacity are in regular operation producing steel, while approximately 100,000 kilowatts of energy have been installed for inductive melting, differential heating, surface hardening and other heat treating operations.

During the week of dedication of the memorial statue of Benjamin Franklin in the central rotunda of Franklin Hall this exhibit will be shown in the Physics Room on the second floor.

The exhibit was a donation of the Ajax Electrothermic Corporation of Trenton, New Jersey.

Spray Gun for Heavy Materials

The Thor Model 7E-1, an improved model over the company's recent 7E spray gun for heavy materials, has just been announced by the Binks Manufacturing Company, 3114-40 Carroll Avenue, Chicago.

The new 7E-1 gun is so designed that heavy materials such as asphalt paints, sound deadener materials containing sand and other abrasives, will flow out easily through the rounded contours from the material inlet to the material nozzle.

The new gun is offered with a variety of nozzle set-ups, and has a ¾" material inlet opening. Like the former 7E, it is of the internal atomization type and nozzles can be furnished to deliver either round or flat spray.

Thor Model 7E-1 spray gun

Duranite Finishes

By **E. H. BUCY***

Technical Director, Zapon Division, Atlas Powder Co., Stamford, Conn.

In the early days of industrial coatings or finishes plain linseed oil, cooked to increase the viscosity and hasten drying, was used. Coatings made in this way were very slow drying, and it was impossible to get light tints or white. These coatings were very poor on resistance to ultra-violet light, and showed early chalking when placed on outdoor exposure.

Later on it was found that cooking with some of the fossil resins such as Congo, Manilla, Pontianak and other fossil copal resins, increased the hardness and durability of the final film, and speeded up the drying rate. The addition of these varnish resins to the cook gave more gloss, and added materially to the adhesion of the finish. There was still bad yellowing on exposure to light, however, and the drying time was not nearly as fast as would be necessary for modern production schedules.

There weren't any noticeable improvements then, until the introduction of ester gum. Ester gum, made by the reaction of rosin and glycerin, was really the first synthetic resin. When cooked with china wood oil, greatly increased speed of drying and water-proofness resulted.

Here, for the first time in the coating field, was the direct influence of the chemist. Rather than taking natural raw materials, with their shortcomings, this was the first step at a synthetic or man-made fortification of the natural products.

A few years later, the development of oil soluble phenol aldehyde resins was the next big step. Properly cooked with oils, these new phenol aldehyde resins produced the first so-called "four hour enamels," and even later, the so-called "one hour enamels." Their water resistance and chemical reagent resistance were higher than anything heretofore produced. True, a good white couldn't be made, because of the discoloring influence of the phenol. However, both for paint work and for industrial finishes, the phenol aldehyde resins showed great advances in durability and speeding up of painting schedules.

Still later, the so-called Alkyd types were developed. These are made by the chemical reaction of a polyhydric alcohol such as glycerin, ethylene glycol, or sorbitol, with an organic acid of the type such as Phthallic acid, maleic acid, tartaric acid, or others. These are reacted either together or with fatty acid modifiers. This Alkyd type of resin has been used widely for refrigerator work as well as automotive and industrial finishing, during the last three or four years. Much purer whites and greater durability have been made possible.

When properly baked, these modified Alkyd finishes gave much greater resistance to weathering, ultra-violet light and abrasion. The baking time, however, must be long enough to permit complete oxidation of the oil or fatty acid modifier component. Due to the presence of the fatty acid, there was after-yellowing on more prolonged exposure to light. If these finishes were not baked at fairly high temperatures, for a fairly long time, the water permeability was higher than was desirable.

The next development was the use of heat reactive or baking finishes, of the urea-formaldehyde type. These are also completely synthetic, in that they are made from chemicals which are reacted to produce the base for them. These new finishes, of which Duranite is an excellent example, may be applied by spray or dip. Their initial set-up is due to solvent evaporation. Therefore there is not the difficulty with sags or runs during application. There is also far less trouble with dust or lint being trapped in the surface before the heat curing operation is completed. Pure whites are easily obtained; these whites having better resistance to exposure and corrosive influences than anything that has been developed up to this time.

These Duranite finishes need only a short period of heat to change them to the insoluble state. Temperatures from 300 to 400° are used, with time varying from a few minutes up to as high as fifteen or twenty minutes.

Washing machines, towel cabinets, refrigerators and general industrial work may be done in one coat. Various modifications of Duranite are necessary, depending on the specific use to which it would be put.

*From a talk before the Springfield, Mass., Branch, A. E. S., Feb. 28, 1938.

The Meaker Process of Electrogalvanizing

By **ERNEST H. LYONS, JR.***

Chemist, The Meaker Company, Chicago, Ill.

In the early 1900's The Meaker Company, Chicago, Ill., was confronted with the necessity of rust-proofing certain steel products which could not be hot-galvanized. The existing methods of electrogalvanizing were tried and failed, one by one. Under the force of necessity, a new process and solution was developed. This process combined an advanced, high-speed electrolyte with scrupulous pre-cleaning of the steel, without which the adherence of the zinc is faulty and its corrosion resistance is impaired.

In galvanizing continuous lengths of cold-rolled strip steel, hot-dip coatings lack uniformity, control of coating thickness is uncertain, and the zinc is brittle and cracks and spalls off in forming operations. Electrogalvanized coatings adhere even to the breaking point of the steel, and are entirely uniform and subject to the closest control from the thinnest blush up to the heaviest coating. Such experience paved the way for the recent extension of the Meaker process to the electrogalvanizing of round wire. The problem of applying a heavy zinc coating in reasonable time and space was solved by modifying the Meaker solution so as to produce smooth, dense, non-porous deposits at current densities up to 2000 amperes per square foot and more. Even the heaviest coatings are deposited in a few seconds.

This aggravated the cleaning problem, for depositing zinc in a few seconds is of no use if half an hour must be allowed for cleaning. Just what makes steel wire so hard to clean is still unknown. Scale, drawing compounds, and other dirt is so imbedded in drawing, that pickling or anodic treatment, even if continued until the steel is almost entirely dissolved, does not provide a surface sufficiently clean for adherent electrodeposits. Even electrodepositing a fresh surface of pure iron is of no avail. In hot galvanizing this difficulty is partially met by the attack on the steel surface by the molten zinc.

After the wire is thoroughly pickled in muriatic acid, the Meaker process employs three unique electrolytic treatments to provide thoroughly reliable cleaning at low cost, and in a few seconds.

The electrogalvanized wire comes from the plating bath bright and lustrous, and needs no polishing or burnishing. The zinc is so ductile that even when the wire is broken, a tiny hinge of zinc remains. Not only is the coating thickness perfectly uniform, but it is under control. Thickness is unlimited from a mere wash of zinc up to 4 ounces per square foot or more.

Wire to be galvanized is butt-welded into continuous lengths on forty big pay-off reels, from which it passes, if desired, through a furnace or lead pan for annealing or normalizing. It enters the pickle tank, and then passes through a spray-rinse to the electro-flash and electro-strike. A second spray-rinse precedes the galvanizing tank, where the zinc is applied after a final cleaning step.

Electric current, entering the solution from the zinc anodes lying just below the wire, dissolves zinc from the anodes and deposits it on the wire.

After flushing off the solution, the galvanized wire is dipped in hot water so that it will dry before being coiled on the take-up blocks. From pickle to this final rinse the machine is about 200 feet long. It galvanizes about 1000 tons per month of No. 12 wire. The tanks are constructed largely of steel, rubber-lined, and are about six and one half feet wide. The wire is guided through them by means of individual sheaves constructed of materials which withstand the chemical actions of the various solutions.

The anodes are bars of pure zinc, about 60,000 lbs. being required for one charge. The 43,000 gallons of Meaker solution are circulated continuously in operation, and are held approximately neutral with the aid of a pH test set.

The controls are grouped on a central panel, and permit the setting of the thickness of coating and speed of production within 1-2%. The customary speed of the wire is about seventy feet per minute. Car-

*From an address delivered at 20th Annual Meeting, American Zinc Institute, Inc., St. Louis, Missouri, April 26th, 1938.

rent is supplied by four 15,000 ampere motor-generator sets.

In spite of the high current density, the cathode efficiency is more than 99%, and substantially all of the zinc used appears on the wire; there are practically no losses. The zinc deposit is exceedingly pure; in fact, electrodeposition is a commercial method for purifying zinc. Applied to any steel, regardless of analysis, the physical characteristics are not altered. With no limits on the thickness of coating, wire may be galvanized to last for any desired period of time. Without doubt the use of galvanized wire will be thereby increased, and the quality of present galvanized coatings will be improved.

It is not intended to suggest that electrogalvanizing is in every case far superior to the older hot-dip method. There are fields for both methods. Certain shapes and products are handled to best advantage by the hot-dip methods; others are much better electrogalvanized. So far as protection goes, evidence from exposure tests remains contradictory; yet it is generally agreed that for equal thickness, hot-dip coatings and electrodeposited coatings give at least the same order of magnitude of protection. The recent well-known tests carried out by the Bureau of Standards, the American Society for Testing Materials, and The American Electro-Platers' Society, indicate that so long as a reasonably good coating is obtained, the degree of protection is more dependent on the thickness of the zinc than on the manner in which it is applied.

Electrogalvanizing does, however, represent a method which has been studied successfully for less than forty years, while hot-dip methods have been used for more than a century. It seems reasonable to expect that advances and extensions are more likely for the electrolytic method. Even now, it offers advantages in adhesion and purity of the zinc coatings. In the case of wire, it can apply heavier coatings than have been attained by hot-dipping.

The development and extension of electrogalvanizing is likely to promote the use of galvanized material rather than merely to replace hot-galvanizing. It will increase the use of zinc, the most powerful protector of steel.

Automatic Polishing and Buffing Machine

The Packer Machine Company, Meriden, Conn., has recently developed a new straight line conveyor type machine for finishing a variety of shapes and sizes of parts.

This machine, being of the conveyor type embodies a new style of exterior design—shielded against abrasive dust. Only the hand wheel controls project from the body design.

The illustration shows the No. 2 straight line conveyor type machine, which is 30 feet 6 inches long and 4 feet 6 inches wide. However, this machine can be furnished with any number of wheel heads depending upon the customer's requirements, thereby increasing or shortening the length of the machine.

The wheelheads are known as the Packer No. 6500 Universal Type with adjustments for setting the wheels at any angle from horizontal to vertical or any angle within the 90 degrees. The wheelheads are arranged with spring balance plates, thus providing a flowing action to the wheels to compensate for any lack of uniformity in thicknesses of the part to be finished and also permitting the finishing of work in various thicknesses.

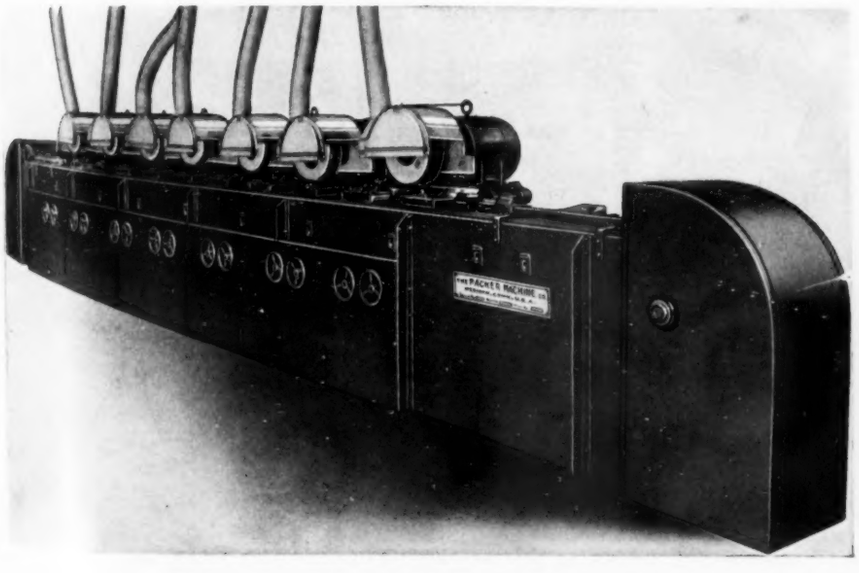
The wheelheads can be furnished with motors of various horsepower depending upon customer's requirements, also supplied with direct driven wheels or multi-"V" belt driven wheel spindles, which permit changing the speed of the wheels necessary for various metals and finishings.

The adjustment for the changing of the position of the wheels is mounted on the front side of the conveyor, as illustrated, permitting the operator to adjust each wheel according to his requirements from the working station or the operating position of the machine.

The conveyor chain is driven by a variable speed unit which permits changing of the speed of the conveyor by adjustment of a control on the drive unit itself. The changing of the speed can be done very quickly by the operator.

All important moving parts on this machine are ball-bearing constructed. The carriers to which the work holding fixtures are fastened, travel on a solid machine surface track, and each carrier is equipped with grease sealed, dust proof, ball bearing rollers. All working parts of the machine are shielded against dirt or abrasive materials coming in contact with moving parts.

In addition to the machine illustrated, these polishing and buffing machines are made in three general types: rotary, vertical portable and the straight line conveyor type.



Packer conveyor type straight line polishing machine

Wrinkle Finishes

In response to an increasing demand for a high quality type of wrinkle finishes, the Stanley Chemical Company of East Berlin, Conn., is now manufacturing the 70F Wrinkle Finishes under a license arrangement with New Wrinkle, Inc.

While it has been comparatively simple to obtain good color and gloss in the coarse wrinkles, the manufacturers claim that in their fine (black) wrinkle they have obtained better gloss and color than has heretofore been possible.

To insure uniform results these materials are shipped ready for use. They are intended for spray application and should be sprayed with about 40 pounds air pressure, without any reduction and baked for two hours at 250° F. It is a characteristic of these materials that they are unaffected by air drying for a reasonable time before baking. Test panels have been air dried for from five minutes up to two hours before baking without any difference in the final appearance or character of the wrinkle.

These materials have been so formulated that if a blemish occurs in the finish it may be sanded down to a smooth surface then retouched with another coat of this wrinkle and rebaked with satisfactory results. The area touched up in this manner cannot be distinguished from the remaining single coat area after baking.

Material Strainer for Spray Guns

Binks Manufacturing Company, 3114 Carroll Avenue, Chicago, has just announced the production of a No. 255 material strainer, which fits on the material inlet of its standard production spray guns for straining the paint which is being delivered to the material inlet of the gun.

Binks No. 225 material strainer

This type of strainer is recommended where it is found that no matter how thoroughly paint is strained before placing it in material tanks or circulating systems, there is still a possibility of some residue getting through to the finished product. Also, it serves as the last cleaning agent to remove any foreign matter which might have been picked up in the hose or the circulating pipe lines; finished with a 250 mesh screen which can be easily removed for cleaning.

pH Sets

A line of analytical sets for measuring and controlling pH (acid or alkalinity of solutions) by the colorimetric comparator method has been rounded out by the Kocour Co., 4724 S. Christiana Ave., Chicago, Ill. Recommended for nickel, copper, zinc, brass, in cyanide and acid solutions, the purpose of these sets is to enable the electroplater to determine the pH of his solution and to know just how much acid or ammonia or other correcting medium to add to change the pH to the desired point. The sets are portable and can be operated at the tank. They are furnished in a number of models with ranges varying from 1.2 to 13.6 pH.

A correction set is also supplied with two bottles of standardized solutions and calibrated droppers complete with directions.

Kocour correction set

Grinding and Polishing Wheels

The Weka line of grinding and polishing wheels is manufactured by Weigert and Spector, 35 Wooster St., New York. This line, it is stated, embodies a new and distinctive contribution to the field of grinding and polishing of metals. The wheels are made of the most highly selected grades of cotton, wool or leather, the choice of material depending upon the type of work which is to be polished.

The abrasive is applied to these wheels in exactly the same fashion as to felt wheels. There is no new process or experimental work involved. The abrasive, it is claimed, adheres to the Weka wheels much better than to other types.

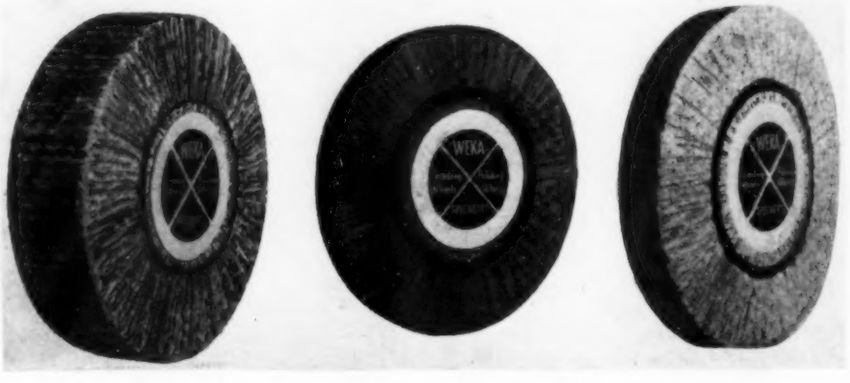
The outstanding claim made for these wheels is their durability and efficiency. Another claim is that because of their composition, there are never any burnt holes. This eliminates the difficult job of grinding off bad spots, created by burning.

The wooden center is guaranteed to hold tight and every wheel is guaranteed to be properly balanced.

For dry grinding, woolen wheels are used; for grease grinding, cotton wheels are recommended; for rough and solid articles the wheels should be made of canvas. For example, grease grinding is practiced on plough shovels, knives, iron pipes, etc. Leather wheels are used where sharp edges are desired and only for grease grinding.

The manufacturers have established a policy of submitting a wheel to any prospect for one month's free trial. They ask only to be given the following information:

1. The purpose of the wheel (type of work to be ground or polished).
2. Diameter and width of wheel, and size of core hole.



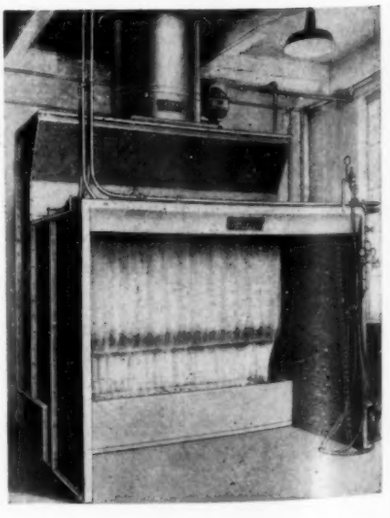
Weka grinding and polishing wheels

"Dynaprecipitor" Unit

The Dynaprecipitor, a new development to take the place of the ordinary water-wash chamber for spray booths, has just been announced by the Binks Manufacturing Company, 3114-40 Carroll Avenue, Chicago.

Using an entirely new principle in the cleaning of paint fumes, the new Binks Dynaprecipitor reclaims all types of paints, synthetic enamel, vitreous enamel, etc. It has no nozzles to clog or wear out and, it is claimed, gives much more efficient elimination of paint pigments from spray fumes (99% efficiency) and is very economical to operate.

The Dynaprecipitor unit is equipped with a special set of precipitator plates which are self cleaning. Another feature is the water curtain which extends the full width of the spray booth. The paint pigments which strike this curtain are washed down into the collecting pan, thereby eliminating the necessity of cleaning the front surface of the unit. Patent applied for.



Binks "Dynaprecipitor"

Cast an eye upon these

SMALL PERCENTAGES

1½% High-speed, precision worm gears withstand extreme pressure and temperature when cast in 1½% Nickel bronze, says Baush Machine Tool Co., Springfield, Mass. Chilled at periphery, Nickel bronze provides increased hardness where stress and wear is greatest. For strength and toughness in bronze castings subject to unusually high stresses, use Nickel.

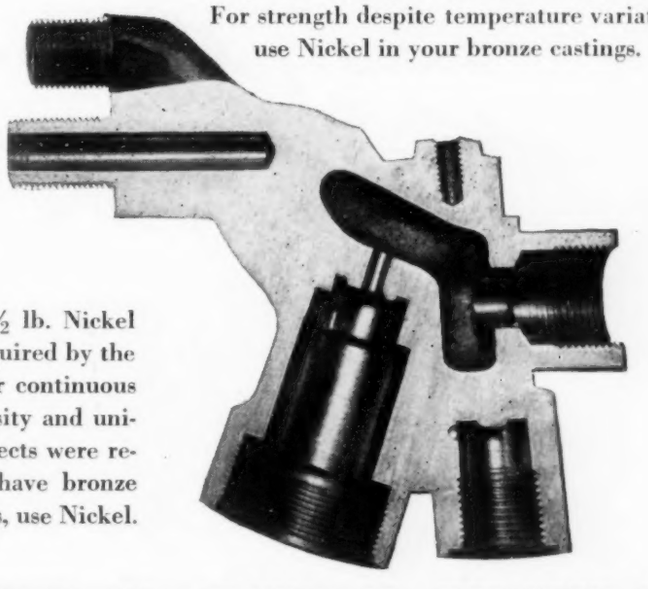
. . . a little

CAST NICKEL BRONZE

helps a lot

1½% G-E oil-cooled transformer parts must stay oil tight hence all bronze castings used (example pictured above) are given a hydrostatic pressure test. For these castings the General Electric foundry at Pittsfield, Mass., add 1½% Nickel to their regular 85-5-5-5 mixture. In one run of 120 castings every part was oil tight after machining. For uniform structure and continued pressure tightness in bronze castings, use Nickel.

1% Locomotive boiler feed pumps must withstand shock, wear and pressure at varying temperatures. These 1% Nickel bronze feed pumps (left) were cast by Textile Machine Co., Reading, Pa., for J. S. Coffin Jr. Co., Englewood, N. J. Tested to 400 p.s.i., "proved satisfactory in every way", says consulting engineer. For strength despite temperature variations, use Nickel in your bronze castings.



1% Seven twisting water passages in a 2½ lb. Nickel bronze casting (right). That was the job required by the Ritter Dental Mfg. Co., Rochester, for their continuous flushing cuspidor. By using 1% Nickel density and uniformity were so improved that foundry rejects were reduced, machining costs lowered. Do you have bronze problems? For uniformity in bronze castings, use Nickel.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

New Buff

The Udylite Company, 1651 E. Grand Blvd., Detroit, Michigan, manufacturers of plating and polishing equipment and supplies announce the new "Masterfold" buff. It is claimed that this buff will give 25% to 75% greater buffing performance—performance being measured in terms of faster cutting, longer buff life, better finish.

The manufacturer states the Masterfold buff is constructed on an entirely new, radically different principle. The cloth is folded in such a manner as to accomplish two main objects, (1) present a multiplicity of cloth edges that cut instead of rub; (2) provide air spaces between the cloth ply to dissipate friction heat generated by pressure of the buff on the work.

Specific advantages claimed for the Masterfold buff are as follows:

More pieces per hour. The Masterfold is an exceptionally fast cutting buff; will reduce buffing time anywhere from 25% to 75%. Composition is held and pocketed so that the efficiency of the operation is maintained with fewer applications to the wheel.

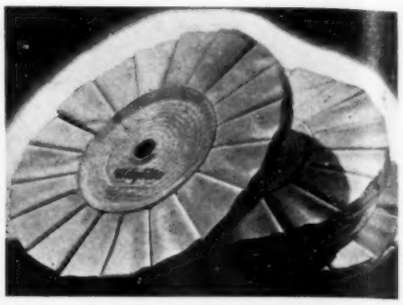
More pieces per wheel. The Masterfold buff will stand up under hard usage. Will not burn as the "open face" construction permits free air circulation which dissipates heat generated by friction between the wheel and the work. Wears down evenly and holds its edge.

Gives a better finish. Produces a better finish on the work, cutting evenly, smoothly, quickly. The buffing action is uniform over the entire face of the wheel and ridging, pitting and chattering are eliminated.

Economical to use. A money saving buff from every viewpoint.

Operators like them. The man on the wheel finds them easy to use. His time and energy are conserved.

It is further stated that Masterfold buffs are designed to buff all metals and plastics and can be used on both automatic buffing machines and hand operated lathes. Best results are secured at speeds of 8000 surface feet per minute. The spindle rpm of the machine should be such that this speed can be secured with the diameter of the buff used.



Udylite "Masterfold" Buff

Vertical Welder

The Harnischfeger Corporation of 4400 W. National Ave., Milwakuee, Wis., announces a new machine in their line of P & H-Hansen electric arc welders—the 150

New P & H-Hansen 150 Ampere Vertical Arc Welder

ampere vertical type welder. Designed to occupy a minimum of floor space, this new welder is a highly adaptable machine, available for a wide range of work in welding the lighter gauge metals, both ferrous and non-ferrous. With plug-in type cable receptacles for easy current reversing, and patented, single-current control, it makes a point of simplicity of welder operation. It is designed, as are all P & H-Hansen welders, for high current uniformity, and is an ideal unit for use in the production welding line where smooth, uniform welds are essential. Furnished in the A.C. drive only, this little machine is less than 4 ft. in overall height. A towing handle provides easy movement around the shop, and ample stability when raised to form a 3-point base.

Mixing Tank

The DeVilbiss Company, Toledo, O., has announced a new hinged lid mixing tank, designed to facilitate economical and efficient agitation or mixing of lacquer, synthetic enamel and other pigmented finishing materials. This tank provides an inert atmosphere for the mixing of these materials, thereby preventing oxidation while handling.

DeVilbiss lacquer mixing tank

Available in 30, 60 and 120 gallon capacities, the tanks are plain, straight-sided shells inserted into a foot ring. Covers are 5/16-inch flat steel stock, hinged across the tank with malleable cast iron hinges.

Clamps render the hinged portion pressure-tight. The remainder of the cover is bolted through a special solvent-resistant gasket into a steel channel welded to the tank lip to provide a gasket recess.

Glass Insulating Tape

Munning & Munning Inc. of 202-208 Emmett Street, Newark, N. J. offer a novel contribution to the electro-chemical industry, in the form of an impregnated woven glass tape for electrical and chemical insulation. This material can be furnished at the present time, on reels as shown in the enclosed cut, in widths from ¼" to 6", with varying thicknesses of coatings and pliability.

Rubberized glass insulating tape is essentially a woven glass fabric made from spun glass fibers impregnated with a synthetic rubber covering. The exceptional thinness and high strength of the glass fabric, combined with the acid resisting and dielectric properties of both the rubber and the glass, enables this tape to be utilized for many purposes.

The development of this appliance being comparatively new, all of its uses have not yet been suggested, but the outstanding present applications are found in its effective employment as an insulating medium between ventilating hoods and plating tanks; direct connected blowers and hoods; as an insulator under conductor bar supports, and as gasketing material on electro-plating equipment. The value of this impregnated tape is enhanced by the fact that it is not absorbent and will repel moisture and water.

Additional to the above, this rubberized glass insulating tape has been found extremely useful for the insulation of heavy duty plating racks of larger cross section; as a desirable covering for steam heating coils at the solution levels where temperature and oxidation react to accelerate corrosion; also as a covering to protect those portions of anode and cathode rods between the anode hooks and the work hooks from becoming spattered with solution which forms incrusted salts and ultimately impairs good contacts.

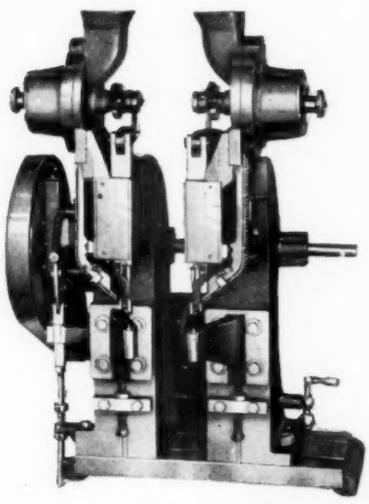
The washable feature of this tape may also be mentioned as an advantage.

In specific instances, this tape has also been used in plating operations as masking band, to stop off deposits on special articles where the tape can conveniently be applied and removed.

Rubberized glass insulating tape

Automatic Multiple Rivet Setter

A new automatic, multiple, bench-type riveting unit, that offers greater flexibility in application to small volume work is a product of the Chicago Rivet & Machine Company, 1810 S. 54th Ave., Chicago, Ill. It is designed with double riveting heads and an adjustable centering device. One head remains stationary, while the other can be adjusted quickly in or out by means



Chicago rivet setter

of a balcrank and lead screw, requiring only a few minutes to change from one center to another. A ¼ HP motor is employed in the drive and a single clutch operates the plunger, providing uniform rivet insertion and closure, as well as eliminating marring of the rivet head or unbalanced tension. Heads may be operated simultaneously to set two rivets at a time or the feed on either head may be locked to permit single rivet setting where necessary or desirable.

Two models are available, one for light, and the other for heavy duty work.

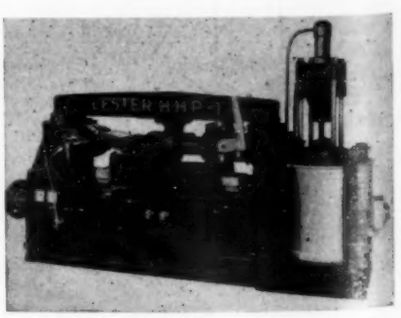
Semi-portable Foundry Sand Conditioner

A new semi-portable foundry sand conditioner designed for grab-bucket feeding is announced by The Jeffrey Manufacturing Co., Columbus, Ohio. This machine tradenamed the No. 3 Sanditioner has a capacity up to 45 T.P.H. Continuous screening is provided by a 3′ x 6′ positive eccentric type screen which discharges refuse to one side. Conditioning is accomplished by a pair of heat-treated cutter bars which are made reversible for double wear. These throw the conditioned sand into piles or windows ready for reuse. The machine has a rigid frame, a 5,000-lb. capacity hopper, stands 8′ high and is provided with grapple eyes for lifting and transport by crane. Other features are: 7½ H.P. totally enclosed, fan-cooled motor; push-button control; V-belt drives; dust sealed anti-friction bearings throughout; and full protection of all moving parts.

Jeffrey sand conditioner

Die Casting Machine

Increases in production ranging up to four times are claimed for the new Lester No. HHP-1 die casting machine by its manufacturers, the Phoenix Ice Machine Company,



Lester No. HHP-1 die casting machine

Church Avenue, Cleveland, Ohio. Principal features claimed are:

A newly developed self-contained injection cylinder actuator.

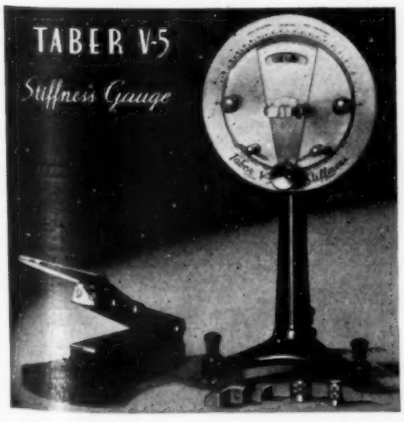
Central adjustment of die space without misaligning die plates, enabling plates to be changed or adjusted in one-fourth the time.

An injecting mechanism of distinctive construction which permits accurate adjustment to and from the die opening. It can be replaced one member at a time.

Stiffness Gauge

Taber Instrument Company, North Tonawanda, New York, announces the Taber V-5 stiffness gauge and triple-cut shear, for the measurement of the stiffness and resilient qualities of light metallic sheet and wire. The triple-cut shear is an important accessory to the V-5 gauge as it blanks out test specimens accurate to size, insuring against dimensional errors associated with single shears. Both units are light and portable and can be used anywhere, in the laboratory, office or plant. It is stated that the gauge's simplicity of operation and quick direct readings make it easy to use, even by those without previous technical experience.

Features: metric calibration with continuous scale from 0-2000 gram centimeters; advanced design, rugged construction; no delicate parts, electrical contacts or connections; sensitive bearings sealed in lubricant for years of service without further attention. Bulletin 3802 will be mailed on request.



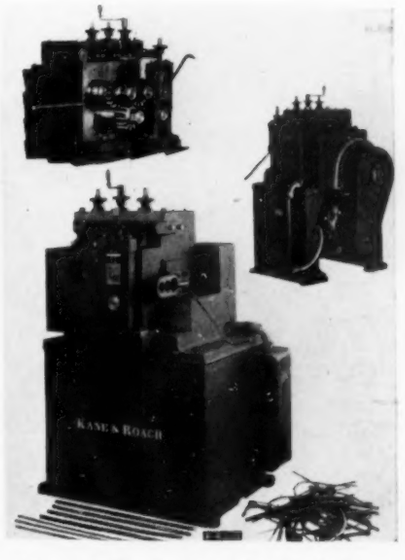
Taber V-5 stiffness gauge

Core Wire Straightener

Kane & Roach, Inc., Syracuse, N. Y., have recently placed on the market an improved No. F 5-roll core Wire Straightener as shown in the illustration.

These machines are primarily designed for removing the sharp bends and kinks from core wire at a high production speed, and placing the stock in reasonably straight condition. Due to the fact that these wires are reused and scaly, and baked in the core ovens, plus the fact that some of the wires are sharply bent and kinked, it is not possible, nor is it necessary for the average core work, to obtain a high degree of straightness. Saving is accomplished by the higher rate of machine straightening as compared to hand straightening, as well as the fact that the wire is reused many times. Without these core wire straighteners, some foundries find the cost of hand straightening so excessive that on their small wires, they scrap them.

The No. F 5-roll wire straightener is listed for approximtaely $\frac{3}{8}$" to $\frac{3}{4}$" core wire, though it has handled down to $\frac{1}{8}$". Kane & Roach build a smaller core wire straightener, known as No. DX, nominal capacity 3/16" to $\frac{3}{8}$", though it has gone down to No. 12 gauge.



Kane & Roach core wire straigthener

What the Reader Says

Welcome to the 1938 Casting Manual!

Fine Appearance

We are in receipt of copy of New Casting Manual for 1938, and wish to congratulate you on its very fine appearance.

AJAX METAL COMPANY
W. J. Coane,
1st V. P. & Sales Manager
Philadelphia, Pa.

Improved Over 1937

We wish to acknowledge receipt of your 1938 Casting Manual. We also wish to commend you on the improvement in form and content of this Manual over 1937.

L. S. COHEN & COMPANY
Wolf P. Cohen
Chicago, Ill.

Good for Training Apprentices

Our foundry superintendent, *George Zabel,* referred me to your copy of Casting Manual and suggested we secure copies for our foundry apprentices. We consider this booklet very good for our boys in training.

FAIRBANKS, MORSE & COMPANY
A. R. Luetke, Supervisor of Apprentices
Beloit, Wis.

Of Considerable Value

We have today received your 1938 issue of Casting Manual for Non-Ferrous Metals, which we find upon examination to be of considerable value. Kindly send us at least a half dozen more copies for distribution to our plant supervisors.

THE GIBSON & KIRK COMPANY
Edwin W. Horlebein, president
Baltimore, Md.

Interesting and Creditable Production

I have just received a copy of the 1938 Manual for Non-Ferrous Metals. I have glanced through it hurriedly and I want to promptly acknowledge it, and tell you that it is certainly a very interesting and creditable production. I know it will be extremely helpful to those in the industry and I congratulate you and its editor, Sam Tour, on the character and completeness of the publication.

Please accept my sincere thanks for favoring me with a copy.

LUMEN BEARING COMPANY
Buffalo, N. Y. *N. K. B. Patch*

Helped Solve Problems

We are pleased to advise that since receiving the Manual we have been able to solve some very important questions that have come up in our plant.

THE SHOOP BRONZE COMPANY
E. V. Shoop, General Manager
Tarentum, Pa.

Fills a Long-Felt Want

We consider this Casting Manual to be one of the most complete works we have ever seen and we highly compliment you on the infinite detail you have gone to in compiling the various data. It certainly fills a long felt want.

AMERICAN CRUCIBLE PRODUCTS COMPANY
G. L. Smith, secretary
Lorain, Ohio.

Plating on Aluminum

Editor METAL INDUSTRY:

In the latest issue of METAL INDUSTRY there was propounded Problem 5651 which was an inquiry concerning a formula for cleaning and plating copper and nickel finishes on aluminum to which you reply, "There is no completely satisfactory method for plating on aluminum at present".

We wish to take exception to this statement and herewith enclose a folder which

will enlighten you on the subject. We also refer you to the enclosed list of men who are quite familiar with what we have been doing for about five years in the way of successfully plating aluminum and any aluminum alloy we ever heard of.

Our process prepares the aluminum or aluminum alloys so it can be plated in any standard nickel solution or bright nickel if you prefer. Afterwards it can be plated with chromium, copper, gold, silver or other metals. We attach copy of report made by one automobile company and can refer you to two others for whom we plated pistons, which were similarly tested and the plating was intact at the end of the tests.

We believe after consulting this array of experts and hearing what they have to say, you will want to correct the statement made in the last issue of METAL INDUSTRY referred to above.

If there is additional information you would like, we would be pleased to furnish it to you.

KROME-ALUME INC.,
O. M. Diall, president

Lockport, N. Y.

Editor METAL INDUSTRY:

Thank you for the interesting reply to our answer to the electroplating on aluminum inquiry.

In the answers given for publication in the METAL INDUSTRY we must of course be as conservative as possible and for the most part we confine ourselves to methods that are standard.

Questions on the plating of aluminum have always been somewhat ticklish to answer and we have not made a practice of giving details as to the best of our knowledge the known methods were not always 100% reliable. However, we are more than glad to have the information about Krome-Alume and we shall be interested to hear what the references you gave have to say. Newark, N. J.

G. B. Hogaboom, Jr.

We have, since this exchange of correspondence, communicated with individuals named by the Krome-Alume, Inc., and have received very high recommendations for this process from several of them.

A description of this process appeared in METAL INDUSTRY for February 1938.—Ed.

Technical Publications

Estimating Life of Electrical Elements, by Francis E. Bash, manager Technical Department, Driver-Harris Co., Harrison, N. J.

Useful data on life expectancy of electrical heating alloys.

Hot-Tinning of Fabricated Articles, by E. J. Daniels. Technical Publications. Series B. No. 7. International Tin Research and Development Council, 149 Broadway, New York.

"Frostiness" in Plumbers' Solder, by F. A. Rivett. Technical Publications. Series A. No. 73. International Tin Research and Development Council, 149 Broadway, New York.

Synopsis of Second General Report 1937. International Tin Research and Development Council, 149 Broadway, New York.

Research on Thin Layers of Tin and other

Watch for the Coming Issues of Metal Industry!

The July issue will be the Post Platers Convention Number. It will have a complete report of the meetings with full details of the educational sessions, abstracts of papers, awards of prizes, new officers elected, entertainment features and all other news of interest.

But that will not be all. The July issue will have our regular quota of technical articles on metal products manufacturing and finishing in all its branches. For example:

The Modern Electrotype Industry. Reproduction by electrodeposition as practiced in two up-to-date plans in New York.

A Report of the Annual Meeting of the American Society for Testing Materials. Events of interest to metal manufacturing and finishing.

The Manufacture of High Grade Valves and Fittings, by Francis A. Westbrook, Mechanical Engineer.

Watch for the Coming Issues of Metal Industry!

Metals; IV. Further Investigation on Corrosion by Oils, by P. J. Haringhuizen and D. A. Was. Technical Publications. Series A. No. 74. International Tin Research and Development Council, 149 Broadway, N. Y.

The Coating of Metals with Tin from the Vapour Phase ("*Stannising*"), by B. W. Gonser and E. E. Slowter. Technical Publications. Series A. No. 76. International Tin Research and Development Council, 149 Broadway, New York.

Government Publications

Marking of Platinum Articles. Bulletin CS66-38, entitled "Marking of Platinum Articles, Made Solely or in Part of Platinum." A standard which has been accepted by the industry and approved for promulgation by the U. S. Department of Commerce. Obtainable from the National Bureau of Standards, Washington, D. C.

Lead Industry in 1937—Advance Summary. U. S. Bureau of Mines, Washington, D. C.

Associations and Societies

Detroit Branch, A.E.S.

T. C. Eichstaedt, Secretary, 679 Virginia Park.

The report in our May issue, page 254 regarding the meeting held on Friday, April 1st, stated, erroneously, that that meeting was the Annual Spring Meeting of the Branch.

The regular monthly meeting and Annual Spring Meeting of the Detroit Branch was held on Friday, May 6th. The following officers were elected for the fiscsal year June, 1938-June, 1939.

President, *J. W. Higgins*

Vice-president, *Carl E. Heussner*

Secretary-Treasurer, *T. C. Eichstaedt*

Librarian, *B. F. Lewis*

Board of Managers: *Chas. Beaubien, Wm. W. McCord, Wright Wilson.*

Dr. Gustav Soderberg of the Udylite Company, gave a talk on bright nickel deposits which was followed by an animated discussion.

The following were elected delegates to the Milwaukee convention: *J. W. Higgins; Wm. Phillips; Carl E. Heussner.* Alternates: *T. C. Eichstaedt, A. J. Spencer, Walter Pinner.*

A buffet lunch was held and the meeting was thoroughly enjoyed by every one of the 200 present.

Electrochemical Society

Headquarters, Columbia University New York.

At the annual meeting of the Electrochemical Society held at Savannah, Georgia, the following new officers of the Electrochemical Society were elected:

President: Robert L. Baldwin, National Carbon Co., Inc., Niagara Falls, New York.

Vice-Presidents: A. Kenneth Graham, Philadelphia, Pa.; Leon R. Westbrook, Cleveland, Ohio; S. Skowronski, Perth Amboy, N. J.

Managers: R. B. Mears, New Kensington, Pa.; H. E. Haring, Summit, New Jersey; L. C. Judson, New York City.

Treasurer: Robert M. Burns, 463 West Street, New York City.

Secretary: Colin G. Fink, Columbia University, New York City.

Personals

John L. Christie

J. L. Christie, for many years chief metallurgist, Bridgeport Brass Co., Bridgeport, Conn., has accepted an appointment as assistant to R. H. Leach, vice-president in charge of production and research of Handy & Harman, Bridgeport, Conn.

Mr. Christie was born January 31, 1894 in Montclair, N. J. He attended the Montclair public schools, graduating from Montclair High School in 1912. He then attended Sheffield Scientific School, graduating with the degree of Ph.B. in chemistry.

Mr. Christie entered the employ of the Bridgeport Brass Company on October 1, 1915. His first duty was to return to the Sheffield Scientific School for two years graduate work in metallography under Dr. C. H. Mathewson, where he received the degree of M. S. in 1917.

During the summer of 1916 and from June 1917 to October 1919, he served as laboratory assistant with the Bridgeport

JOHN L. CHRISTIE

Brass Co. From 1919 to 1938 he has held the post of metallurgist in charge of the laboratories.

Mr. Christie is an active worker in technical societies. He is a member of the A. I. M. E. (Institute of Metals Division); a member of the Institute of Metals (British); of the American Chemical Society; of the American Society for Metals; the Electrochemical Society.

His fraternities are Phi Sigma Kappa and Sigma Xi. His clubs, the University Club of Bridgeport and the Fairfield Beach Club. He is a past chairman of the Institute of Metals Division, A. I. M. E., and is now serving his third year as director of that Institute.

Mr. Christie was married on September 25, 1925 to Aretta Sherwood Burr, and they have three children, John Livermore, Jr., Thomas Sherwood and Donald Burr Christie.

Mr. Christie modestly gave his hobbies as working around the home and fishing. It is well known to Mr. Christie's multitude of friends that his "hobbies" also include working for the good of his industry and profession in every way imagineable.

R. E. Falk

At the annual meeting of Revere Copper and Brass Incorporated, held in Baltimore, Maryland, on April 5, 1938, Rollo E. Falk, Vice President in Charge of Manufacturing, was elected to the Board of Directors.

Mr. Falk entered the brass business in 1919 as Production Clerk for the Brass & Copper Company of Chicago. The next year when the new plant of this company was established at Orleans Street, Chicago, in addition to his production duties, he became Purchasing Agent.

In 1923 Mr. Falk became Works Manager and was elected to the Board of Directors; and in 1925, when the new brass rolling mill was completed on Natchez Avenue, the present site of the Dallas plant, he was made Vice President in Charge of Manufacturing.

ROLLO E. FALK

Incidentally, this was the first brass rolling mill in Chicago.

In 1927 a new copper mill was completed under Mr. Falk's direction. In this mill innovations for materials handling entirely new to the copper and brass industry were included.

When the Dallas Brass & Copper Company was consolidated with five others to form Revere Copper and Brass Incorporated, Mr. Falk continued as Works Manager of the Dallas Division of Revere.

During this time Mr. Falk had complete supervision and responsibility for the building of a new and modern office building which was completed in 1931.

In 1932, Mr. Falk was made General Manufacturing Manager for Revere Copper and Brass Incorporated with headquarters at Rome, New York. Later he moved his office to New York City. In 1933, he became a Vice President of Revere in Charge of Manufacturing, a position he still holds.

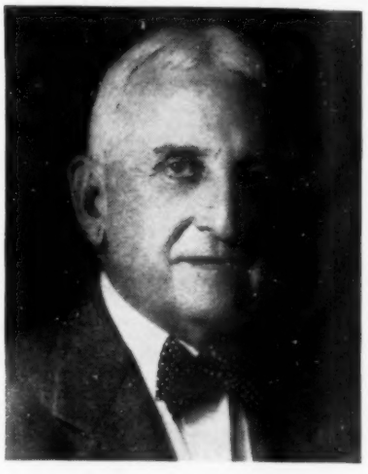
Above all things, Mr. Falk is an organizer. He has surrounded himself with an unusually

well qualified staff of assistants. He will fight for his beliefs and has no hesitation in scrapping outmoded machinery and methods.

Mr. Falk is married and has one son. Golf is his principal hobby.

Frederick S. Chase Retires

Frederick S. Chase, for twenty years president of the Chase Companies, Waterbury, Conn., and over fifty years associated with Chase Companies, has retired from



FREDERICK S. CHASE

active duty. He will continue to serve in an advisory capacity and to assist the officers on every possible occasion.

Charles E. Hart, vice-president and secretary of company becomes executive vice-president. He will be succeeded as secretary by *Seymour Scott Jackson.*

C. J. Kennedy has been appointed sales manager for the McAleer Manufacturing Co., 2431 Scotten Ave., Detroit, Mich. Mr. Kennedy has been a member of the McAleer organization for a number of years.

George B. Hogaboom, Hanson-Van Winkle-Munning Co., Matawan, N. J., spoke at a meeting of the New Jersey Chapter of the American Society for Metals on Monday, May 9th, held at the Essex House, Newark, N. J., on the subject of Metal Coatings.

Harrison G. Travis was appointed General Sales Manager with the title of Vice-President of the Schwartz Manufacturing Co., Two Rivers, Wisc., manufacturer of cotton buffing wheels. Mr. Travis was formerly Eastern representative of the company, with sales offices at 1 Linden Ave., Locust Point, Locust, N. J.

J. F. Gruber has been appointed Factory Representative for the state of Wisconsin, by Hisey-Wolf Machine Company, Cincinnati, Ohio. Mr. Gruber's headquarters are at 528 E. Montana St., Milwaukee.

Dr. V. De Nora of Milan, Italy has been awarded by *The Electrochemical Society,* the tenth *Weston Fellowship* of $1,000. Dr.

De Nora will continue his research at Columbia University, investigating the codeposition of metals in the ionic and colloidal states, and the application of the Faraday law. The work will be done under the direction of *Prof. Colin G. Fink.*

J. B. Wittrup, for 23 years connected with The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., has been appointed Manager of the Chicago Mechanical Rubber Branch. Mr. Wittrup will serve under *John H. Merrell,* Vice President of Raybestos-Manhattan, Inc., who is in charge of sales in the Mid-Western District.

Wilfred S. McKeon, president Sulphur Products Co., Greensburg, Pa., was elected a director of Advertising Affiliation, a body composed of 13 advertising and sales clubs in the United States and Canada, at their recent meeting in Hamilton, Can.

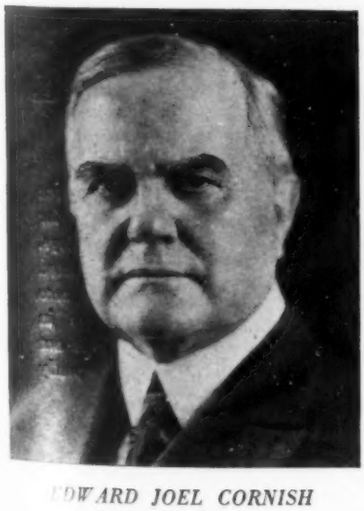
H. V. Walker Co. of Elizabeth, N. J., announce the appointment of *William J. DeVoti,* of Newark, N. J., as their sales representative covering the Metropolitan area. Mr. DeVoti is well known in the plating industry and has a large following of friends who wish him well.

Obituaries

Edward Joel Cornish

Edward Joel Cornish, Chairman of the Board of the National Lead Company, was found dead at his desk in his office at 111 Broadway, New York, at 2:30 p.m., May 3rd. Death was caused by a heart attack.

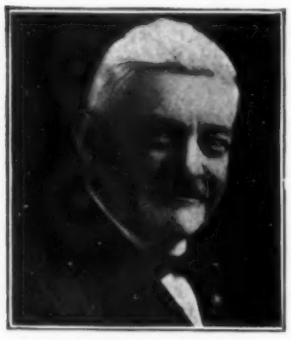
Mr. Cornish was 76 years old. He entered industry in 1903 as counsel for the estate of Levi Carter, who had been president of the Carter White Lead Company. In 1908 he became a director of the National Lead Company and in 1916 its president. Mr. Cornish was a director of the Chase National Bank, Chairman of the board of Patino Mines and Enterprises Consolidated, and a director of the Baker Castor Oil Company.



EDWARD JOEL CORNISH

John C. Campbell

John C. Campbell, president of the Newark Wire Cloth Co., Newark, N. J., died March 18 at his home in Newark, after a short illness at the age of 78. Mr. Campbell had been connected with the wire cloth industry, in which he was a leading figure, for more than sixty years. He started working at



JOHN C. CAMPBELL

the age of seventeen in the Stephens Mills, later known as the DeWitt Wire Cloth Company. He developed many special processes for the weaving of wire cloth and greatly aided in raising the standard of this product to a high level. He perfected a spiral-weave filter cloth which is now in use throughout the world.

John H. Mills

John H. Mills, director and vice-president of the Hilo Varnish Corporation, Brooklyn, N. Y., died at his home in Garden City, L. I., on March 12th. Death was caused by pneumonia. Mr. Mills joined the Hilo company in 1885 and remained active until a few days before his death. He was widely known in the paint industry and devoted much of his time to the development of varnish products for use in the ink and printing trades. He is survived by his widow and one daughter.

Silas A. Tucker

With deep regret The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., announces the death on Thursday, April 14, in the Presbyterian Hospital, of Silas A. Tucker, of Evanston, Illinois, Manager of the Chicago Mechanical Rubber Goods Branch.

Mr. Tucker, who was 51 years old, had been with Manhattan for more than 25 years. For many years he had been Manager of the Chicago Branch. He was an alumnus of the University of Chicago and was a member of the Chicago Club, the Chicago Athletic Club and the Skokie Country Club.

Funeral services were held in the Second Presbyterian Church, in Evanston. Burial was in Forest Home Cemetery.

D. W. Robinson

D. W. Robinson who recently retired from active service after fifty-two years in electroplating, died on April 27th.

A biography of Mr. Robinson appeared in our February issue, pages 95-96. His reminiscences which are appearing serially tell an interesting story of one of the pioneers of the electroplating industry. The first installment appeared in our April issue, pages 182-183.

Samuel L. Lyons

Samuel L. Lyons, proprietor of the Muller Art Plating Company, 241 Centre St., New York, died on May 12 at the age of 78. Mr. Lyons was one of the best known electroplaters in New York City.

Mr. Lyons entered the plating business in 1900 when he took over the Muller Art Plating Company, which has been in existence since 1850. He was at one time very active in association work in his industry, and was past president of the local platers' association. He was president of the Community Association of Stewart Manor, Garden City, L. I., where he resided.

The Muller Art Plating Company will be incorporated and continue under the supervision of John J. Fannon, who has worked with Mr. Lyons for many years.

Earl R. Muldrew

Earl R. Muldrew president of the Metal Finishing Products Co., died recently in suburban Los Angeles at the age of 44.

Verified Business Items

Firestone Steel Products Corp., Akron, Ohio, has just completed the installation of a large new plating plant in Wyandotte, Mich.

Cleveland Tungsten Mfg. Co., Inc., Cleveland, Ohio, announces the official opening of a new and modern factory at 10200 Meech Avenue. The company specializes in the manufacture of tungsten products, such as: tungsten contacts, tungsten copper alloy, tungsten rod, tungsten strip, tungsten electrodes, etc.

Parker Rust-Proof Company, Detroit, Mich., has completed a new office building and laboratory which has been under construction for the past few months. New laboratory equipment has been installed and is in operation.

Fisher Brass Co., Marysville, Ohio, manufacturer of brass and bronze products, has let general contract for one-story addition. Cost close to $40,000 with equipment. Departments: stamping, soldering, welding, grinding, sand blasting, polishing, plating, buffing, coloring. Principal base metal used: brass.

Leggett & Platt Spring Bed & Mfg. Co., Carthage, Mo., metal springs, spring mattress units, has bought and will remodel a building at 2003 Oak Lawn Ave., Dallas, Tex., for a new branch plant. Cost close to $60,000 with machinery. Principal base metal used: steel.

Eberhard Mfg. Co., Cleveland, Ohio, a division of the Eastern Malleable Iron Co., will soon complete an extensive plant improvement program. New machinery is being installed in the Eberhard machine shops and the program also includes installation of equipment for a continuous production line in the foundry. Departments: welding, grinding, sand blasting, polishing, cleaning, plating, tumbling, buffing.

American Seating Co., Grand Rapids, Mich., has plans for a one-story addition to cost over $45,000 with equipment. The company manufactures metal frame seating equipment for schools, theatres, etc. Departments: rolling, drawing, spinning, stamping, brazing, welding, grinding, sand blasting, polishing, cleaning, tumbling, lacquering, enameling, finishing. Principal base metal used: steel.

Connecticut Blower Company, Hartford, Conn. through Charles H. Keeney, General Manager announces the appointment of *Edw. F. Klick*, Rochester, N. Y. as their special sales engineer for the sale of their products in New York State. Mr. Klick has had a very broad, technical and practical experience in the blower line.

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn., has announced the following promotion: *Harold D. Fairweath*, vice-president and treasurer has been elected first vice-president to succeed the late first vice-president, *Frederick T. Moore*.

Michigan Alumina Products, Inc., 505 Tussing Bldg., Lansing, Mich., metal fabricator, has been incorporated with 50,000 preferred and 150,000 shares no par value by *H. E. Neller*, R.F.D. 4.

Star Metal Products, Inc., care of *Charles Rosenblum*, 66 Goldsmith Ave., Newark, N. J., president, has leased about 8,400 sq. ft. of space in Waverly Terminal Bldg., N. Broad St., Elizabeth, N. J., for a new plant. The company will manufacture light metal stampings and will conduct a general machine works.

National Metal Products Corp., 532 Mulberry St., Newark, N. J., sheet metal products, has acquired a one-story building at 238-40 Astor Street and will improve for plant.

Charles L. Gleeson Company has leased a building at the rear of 35-37 Ellis St., Irvington, N. J., for a new plant. Present works will be removed to the new location and capacity will be increased. The company manufactures wire cloth.

Jackes-Evans Manufacturing Co., 4400 N. Union Blvd., St. Louis, Mo., has let general contract for a one-story addition, 40 x 105 ft. to cost about $40,000 with equipment. The company manufactures stoves and parts, sheet metal products, etc.

A. J. Wadhams, vice-president of The International Nickel Company, Inc., 67 Wall St., New York, and manager of its development and research division announced today the establishment in Pittsburgh of a branch office to promote the use of nickel steels and other nickel alloys. *H. V. Beasley*, for the past three years attached to the division in New York, will be in charge of the office which is located in the Grant Building.

Oscar B. Bach has re-entered the field of manufacture of decorative metal accessories. The firm is known as *Bach Products, Inc.*, 288 E. 18th St., Paterson, N. J. The plant employs approximately 100 people. The new industry will fabricate a wide variety of decorative home furnishings, and metal art objects for the department store and art and gift markets. *Charles E. Bloom*, Paterson, is associated with Mr. Bach.

Oliver H. Van Horn Company, Inc., New Orleans, Louisiana, with branches at Houston, Texas, Shreveport and Baton Rouge, Louisiana, has added the complete line of Stanley Electric Tools to its stock of supplies and equipment for the industrial and automotive trade.

Pangborn Corporation announces the removal of their New England Offices to 175 State Street, Springfield, Mass. to be in charge of *J. H. Connolly*, who was previously connected with the Company's Detroit Office.

Associates Manufacturing Co., Bucyrus, Ohio, has been organized to finish aluminum cooking utensils distributed by *Cookware Associates* of the same city. This company finishes castings, polishing them and putting them through a chemical treatment which makes them less liable to staining.

Midwest Sand & Supply Co., Edwardsville, Ill., has been appointed representatives of the *Cleveland Quarries Co.*, Cleveland, Ohio, for the sale of all grades of foundry supplies, (having a complete line, including molding sands from Illinois, Ohio and New York), in Missouri, Kansas, Iowa, Nebraska, Oklahoma, Texas and Illinois, south of Springfield. *T. C. Hamlin* is manager.

Lincoln Electric Co., Cleveland, Ohio, *J. F. Lincoln*, president, announces establishment of a manufacturing subsidiary to be called *Lincoln Electric Company (Australia) Pty. Ltd.*, at Sydney, Australia. A factory has been purchased and arc welding equipment manufacturing operations will begin in a year's time.

The *Packer Machine Company*, Meriden, Connecticut, pioneer builders of automatic polishing and buffing machines, have recently purchased a new factory located at 452-456 Center Street, Meriden, Connecticut. The new building is of fire-proof construction, of modern design, and increases the amount of floor space approximately 400% more than the old location on Britannia Street.

Metals for the Photographer

By M. W. SCHWARZ
Chemical Engineer

Some interesting applications of metal finishes and alloys were in evidence at the First International Photographic Exposition, held at Grand Central Palace, New York City, April 18-24, 1938. Chrome plate, which is in general use on cameras and synchronizers, is frequently satin finished rather than bright, in order to diffuse the reflected light. Movie cameras and photo enlargers are decorated with the wrinkle finish, usually in black or brown.

Sand cast aluminum alloys are finding favor with many manufacturers in the production of their equipment parts. *Simmons Brothers*, Long Island City, New York, use sand cast 3S alloy for projector heads, focusing mounts, sliding mechanisms and base castings of their Omega enlarger. Lamp parabolic reflectors manufactured by *Sun Ray Photo Company, Inc.*, New York City, are made of aluminum, with their inner reflecting surfaces chemically etched. This is said to give a more uniform reflecting surface than the scratch-brushing formerly used.

Wabash Photolamp Corporation, Brooklyn, New York, manufactures the Superflash photo lamp, which embodies a number of novel features. The spectrum of this lamp is said to match the spectrum of sun light closely, so that light filters are not needed. It is also claimed that the longer time interval of the peak intensity of the flash does not demand exact synchronizing for a satisfactory photograph. Instead of aluminum foil, Superflash contains very fine Hydronalium (aluminum-magnesium alloy) wire in an atmosphere of pure oxygen. The wire is 32 microns diameter (a micron is 0.001 millimeter) and in its fabrication, the annealing must be controlled carefully with respect to temperature and time. During the drawing, the wire moves at 1000 meters per minute and an unbroken length of 6000 meters can be obtained. A maximum of 15 dies can be employed, without the necessity for intermediate annealing. Slippage on drawing rolls does not exceed 5% of elongation. Lubrication in a process of this nature of course presents problems that are not generally encountered in drawing wire, and this phase has not been disclosed by the manufacturers. The lamp bulbs are manufactured in Brooklyn, New York, but the wire is imported from Holland, as apparently no manufacturers in this country are equipped to produce wire of this type. The wire remains untarnished on the reels during shipment and storage.

Motion Picture on Nickel

A seven-reel motion picture in sound entitled "Nickel Highlights" was shown by the International Nickel Company to members of its New York staff during the week of May 16th at 67 Wall Street. Prepared by International Nickel, the picture shows the company's plants and a cycle of operations in Canada, Great Britain and the United States.

Opening with scenes of the company's mines, power plants and refineries in the Sudbury basin in Canada, pictures of operations in this locality include a hydro-electric power plant at High Falls mines and the refining plant at Copper Cliff. Included also in the showing are the extensive operations in Great Britain, comprising a large refinery in Wales, the research laboratory, electric furnace manufacturing plant and a rolling mill at Birmingham, England, and the Scotch extrusion tube works at Glasgow.

One of the most interesting parts of the film shows the precious metals refinery at Acton, England where gold, silver and platinum are refined chemically and electrolytically. A considerable portion of the film is devoted to showing the Huntington, West Virginia plant.

Lea Company Outing

An outing of the Lea Manufacturing Company, Waterbury, Conn., was held at the farm of *R. S. Leather*, president of the company, near Bethlehem, Conn., on Saturday, May 21st. A large number of personal and business friends in the industry were present, the attendance being reported as about 90, all from New England. Among those present were *W. J. R. Kennedy*, Executive Secretary of the American Electro-Platers' Society.

The day was devoted to sports and a general good time. The trap shooting contest using clay pigeons was run by *Earl Couch;* the horseshoe pitching contest was managed by *R. P. Crane. George Muscio* ran the archery contest. *Dr. H. L. Kellner* acted as chief photographer. A tavern was set up in the barn in which hamburgers and other refreshments, dry and wet, were served.

A baseball game was held between *Charlie Nardozzi's* Plater All Stars and Dick Crane's Lea Mfg. Co. Invincibles at the Bethlehem Ball Park. Nobody bothered to keep score!

Metal Market Review

May 24, 1938.

Copper registered no change in the domestic price for the first four weeks since our last issue, but the markets abroad became steadily weaker, the export price slipping as low as 9.50c per lb. electrolytic, c.i.f. Finally, on May 19th a custom smelting interest dropped its quotation to 9c per lb. delivered Connecticut Valley. The size of the reduction was the most surprising fact.

Domestic sales of copper for the previous foor-week period were 4,836, 5,720, 4,526 and 4,153 tons, making a total of 19,235 tons compared with 28,448 tons for the previous five-week period. Domestic sales for April amounted to 22,790 tons compared with 22,012 tons in March. Stocks of domestic copper increased a net of 7,740 tons compared with an increase of 11,344 tons in the previous month. Statistics of foreign copper were not available for some time but when they came out they showed a decrease of 11,500 tons.

The cut in price has so far been unsuccessful in stimulating demand and foreign prices have resumed their downward path, resting at this time at about 8.55.

Present situation dull and unstable.

Zinc also suffered a sinking spell. After the moderate improvement noted in these columns last month which returned the price to 4.25c per lb. E. St. Louis, offerings began to come in at 4.15 but resulted in little stimulation of business. On May 10 sellers dropped quotations to 4c which brought out a fair inquiry for metal for forward delivery.

Zinc stocks in the U. S. increased 17,229 tons during April. Producers are not offering metal for anything beyond July delivery, and recent volume has been improved but the market is still uncertain.

Hotels and Reservations for the Platers' Convention

	Single	Double
New Hotel Randolph 649 N. Fourth Street	$1.50 to $3.50	$2.50 to $5.00
Hotel Wisconsin N. Third at W. Wis.	$1.50 to $4.00	$2.50 to $5.00
Hotel Medford Milwaukee, Wis.	$1.75 to $3.00	$2.50 to $4.50
Hotel Schroeder Milwaukee, Wis.	$3.00 to $7.00	$5.00 to $10.

In addition to the above hotels listed there are approximately 30 more in the surrounding territory. Under no conditions are the prices raised. This is controlled by state regulation.

Make your reservations early. For further information please communicate with

IRVING M. HERRMANN,
Chairman of Hotels & Reservations,
906 E. Bay Street,
Milwaukee, Wisconsin.

Transportation

For further information about Transportation please communicate with

JOS. BYKOWSKI,
2762 N. Sherman Blvd.,
Milwaukee, Wisconsin.

Tin had a bad time. For a while it hovered uncertainly around 37 to 38c per lb. Straits. Then with quota restrictions, buffer pool and other plans for controlling output seemingly breaking down in general disagreement, the price suddenly broke to 35c and while it rebounded on reassuring reports to over 38, it has since sagged to a present figure of 36.

Present situation—no stability or certainty discernible.

Lead remained at 4.35c per lb., St. Louis, during the entire last four weeks. The market was not active but neither was it stagnant. Sales were week by week 2,278, 2,083, 2,690, 2,165 tons making a total of 9,216 tons compared with 12,708 tons in previous five-week period. Late in May the statistics for April were published, showing an increase in stocks of 13,200 tons of refined metal. This was followed by a cut in price to 4.10 and then to 4.

Silver unchanged and steady at 42¾c per oz. Troy.

Scrap metals followed a downward path steadily, and with the decline of prices abroad, bids for export almost ceased. Brass and aluminum ingots were very dull and prices were soft.

On May 1st, unfilled orders on the books of the members of the Non-Ferrous Ingot Metal Institute amounted to 9,703 net tons against 10,488 tons on April 1st.

The combined deliveries of brass and ingots and billets for members in the month of April amounted to 2,734 tons compared with 3,305 tons in March.

The Institute reports prices per pound received by its members for commercial grades on ingot brass and bronze during the 28-day period ending April 15 as follows:

	4 wks. end. Mar. 18	4 wks. end. April 15
80-10-10	11.806	11.994
78% Metal	9.333	9.320
81% Metal	9.528	9.668
83% Metal	9.784	9.840
85% Metal	10.074	10.067
No. 1 Yellow	8.408	8.291

Average Prices for Metals

	Apr.
COPPER c/lb. Duty 4c/lb.	
LAKE (del. Conn. Producers' Prices)	10.062
ELECTROLYTIC (del. Conn. Producers' Prices)	10.000
CASTING (f.o.b. ref.)	9.565
ZINC (f.o.b. E. St. Louis) c/lb. Duty 1¾ c/lb.	
Prime Western (for Brass Special add 0.05-0.10)	4.155
TIN (f.o.b. N. Y.) c/lb. Duty Free, Straits	41.152
LEAD (f.o.b. St. L.) c/lb. Duty 2½ c/lb.	4.35
ALUMINUM c/lb. Duty 4 c/lb.	20.000
NICKEL c/lb. Duty 3 c/lb. Electrolytic 99.9%	35.000
ANTIMONY (Ch.) c/lb. Duty 2 c/lb.	15.65
SILVER c/oz. Troy, Duty Free	42.75
PLATINUM $/oz. Troy, Duty Free	35.000
GOLD—Official U. S. Treasury Price	35.000

Supply Prices, May 27, 1938

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER: Cast ..... 18⅝c. per lb.
Electrolytic, full size, 13⅝c. cut to size .. 13⅝c. per lb.
Rolled oval, straight, 14⅛c.; curved .... 18⅛c. per lb.
BRASS: Cast ..... 17⅜c. per lb.
ZINC: Cast ..... 11¼c. per lb.

NICKEL: 90-92%, 16" and over ..... .45 per lb.
95-97%, 16" " " ..... .46 per lb.
99%+cast, 16" and over, 47c.; rolled, depolarized, 16" and over, 48.
SILVER: Rolled silver anodes .999 fine were quoted May 27, from 46c. per Troy ounce upward, depending on quantity.

White Spanish Felt Polishing Wheels

Diameter	Thickness Under ½"	½-15/16"	1-2"	2-3½"	Over 3½"
Under 1"	6.35-6.40	6.20-6.25	6.10-6.15	6.10-6.15	6.35-6.40
1" to 1 7/16"	5.85	5.70	5.60	5.60	5.85
1½" to 3 15/16"	5.55	5.35-5.40	5.30-5.35	5.30-5.35	5.60
4-5 15/16"	4.95-5.00	4.70-4.85	4.65-4.75	4.65-4.75	4.95-5.00
6", 8" & 9"	3.80-4.25	3.45-3.95	2.45-3.05	2.45-3.00	2.90-3.35
10" to 18"	3.80-4.25	3.45-3.95	2.45-2.95	2.45-2.85	2.90-3.25
Over 18"	3.80-4.25	3.45-3.95	2.70-3.05	2.70-3.00	2.90-3.35

Prices above are for less than 50 lb. For over 50 lbs. various discounts or deductions are allowed.

On grey Mexican wheels deduct 10c per lb. from above prices.

Cotton Buffs

Full disc open buffs, per 100 sections when purchased in lots of 100 or less are quoted:

16" 20 ply 84/92 Unbleached	$75.24
14" 20 ply 84/92 Unbleached	57.67
12" 20 ply 84/92 Unbleached	43.28
16" 20 ply 80/92 Unbleached	63.28
14" 20 ply 80/92 Unbleached	48.57
12" 20 ply 80/92 Unbleached	36.52
16" 20 ply 64/68 Unbleached	59.69
14" 20 ply 64/68 Unbleached	45.84
12" 20 ply 64/68 Unbleached	34.49

⅜" Sewed Buffs, per lb., bleached or unbleached 54c to 90c

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone C. P. l.c.l. Drums	lb.	.06¼
Acid—Boric (Boracic) granular, 99½+% ton lots	lb.	.05¼-.05¾
Chromic, 100 lb. and 400 lb. drums		.16¾-.17¼
Hydrochloric (Muriatic) Tech., 20 deg., carboys	lb.	.027
Hydrochloric, C. P., 20 deg., carboys	lb.	.08
Hydrofluoric, 30%, bbls.	lb.	.07-.08
Nitric, 36 deg., carboys	lb.	.06
Nitric, 42 deg., carboys	lb.	.07½
Sulphuric, 66 deg., carboys	lb.	.02½
Alcohol—Butyl, drums (f.o.b. destination)	lb.	.10-.10½
Denatured, carloads, indust., (f.o.b. prod. pts.)	gal.	.33-.38
Alum—Lump, barrels	lb.	.0340-.0365
Powdered, barrels	lb.	.0355-.0380
Ammonia, aqua, com'l., 26 deg., drums, carboys	lb.	.02½-.05¼
Ammonium—Sulphate, tech., bbls.	lb.	.03½-.05
Sulphocyanide, technical crystals, kegs	lb.	.55-.58
Arsenic, white kegs	lb.	.04½-.05
Asphaltum, powder, kegs	lb.	.23-.41
Benzol, pure, drums	gal.	.41
Borax, granular, 99½+%, ton lots	lb.	.0255-.0305
Cadmium oxide, 50 to 1,000 lbs.	lb.	1.20
Calcium Carbonate (Precipitated Chalk), U. S. P.	lb.	.05¾-.07½
Carbon Bisulphide, drums	lb.	.05¼-.06
Chrome, Green, commercial, bbls.	lb.	.22
Chromic Sulphate, drums	lb.	.26¼
*Copper—Acetate (Verdigris)	lb.	.25
Carbonate, 53/55% cu., bbls.	lb.	.14-.15
Cyanide (100 lb. kgs.)	lb.	.34
Sulphate, tech., crystals, bbls.	lb.	.0470
Cream of Tartar Crystals (Potassium Bitartrate)	lb.	.20¼-.20½
Crocus Martis (Iron Oxide) red, tech., kegs	lb.	.07
Dextrin, yellow, kegs	lb.	.05-.08
Emery Flour (Turkish)	lb.	.07
Flint, powdered	ton	30.00
Fluorspar, bags	lb.	.03½
*Gold Chloride	oz.	$18¼-23
*Gold Cyanide, Potassium 41%		$15.45
*Gold Cyanide, Sodium 46%		$17.10
Gum—Sandarac, prime, bags	lb.	.50
Shellac, various grades and quantities	lb.	.21-.31
Iron Sulphate (Copperas), bbls.	lb.	.016
Lead—Acetate (Sugar of Lead), bbls.	lb.	.10-.12¾
Oxide (Litharge), bbls.	lb.	.12½
Lime Compositions for Nickel	lb.	.09½-.11
Lime Compositions for Brass	lb.	.09½-.11
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Methanol, (Wood Alcohol) Pure, drums l.c.l.	gal.	.40½
Nickel—Carbonate, dry bbls.	lb.	.36-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.13½-.14½
Salts, double, 425 lb. bbls.	lb.	.13½-.14½
Paraffin	lb.	.05-.06
Phosphorus—Duty free, according to quantity	lb.	.35-.40
Potash Caustic Electrolytic 88-92% broken, drums	lb.	.07¼-.08⅝
Potassium—Bichromate, casks (crystals)	lb.	.09¾
Carbonate, 98-100%	lb.	.06¾
Cyanide, 165 lbs. cases, 94-96%	lb.	.52½
Pumice, ground, bbls.	lb.	.03
Quartz, powdered	ton	$30.00
Rosin, bbls.	lb.	.04½
Sal Ammoniac (Ammonium Chloride) in bbls.	lb.	.05-.07½
*Silver—Chloride, dry, 100 oz. lots	oz.	.38¾
Cyanide, 100 oz. lots	oz.	.42¾
Nitrate, 100 ounce lots	oz.	.33¼
Soda Ash, 58%, bbls.	lb.	.0235
Sodium—Cyanide, 96 to 98%, 100 lb. drums	lb.	.15
Hyposulphite, kegs, bbls.	lb.	.03½-.06½
Metasilicate, granular, bbls.	lb.	3.15
Nitrate, tech., bbls.	lb.	.029
Phosphate, tribasic, tech., bbls.	lb.	.03
Silicate (Water Glass), bbls.	lb.	.01½
*Stannate, drums	lb.	.26½-.29½
Sulphocyanide, drums	lb.	.30-.35
Sulphur (Brimstone), bbls.	lb.	.02¾
*Tin Chloride, 100 lb. kegs	lb.	.32
Tripoli, powdered	lb.	.03
Trisodium Phosphate—see Sodium Phosphate.		
Wax—Bees, white, ref. bleached	lb.	.60
Yellow, No. 1	lb.	.45
White Silica Compositions for Brass	lb.	.07½-.10
Whiting, Bolted	lb.	.02½-.06
Zinc—Carbonate, bbls.	lb.	.14-.15
Cyanide (100 lb. kegs)	lb.	.33
Chloride, drums, bbls.	lb.	.065
Sulphate, bbls.	lb.	.04

* **Subject to fluctuations in metal prices.**

Metal Prices on page 318.

Metal Prices, May 27, 1938

(Import duties and taxes under U. S. Tariff Act of 1930, and Revenue Act of 1932)

New Metals

COPPER: Lake, 9.125, Electrolytic, 9.00, Casting, 8.525.
ZINC: Prime Western, 4.00. Brass Special, 4.10.
TIN: Straits, 35.70. LEAD: 3.85.
ALUMINUM: 20. ANTIMONY, Ch. 14.00.
NICKEL: Shot, 36. Elec., 35.

QUICKSILVER: Flasks, 75 lbs., $82. BISMUTH, $1.05.
CADMIUM, .85-$1.20. SILVER, Troy oz., official pr. N. Y., May 27, 42¾c.
GOLD: Oz. Troy, Official U. S. Treasury price $35.00.
SCRAP GOLD, 6¾c. per pennyweight per karat, dealers' quotation.
PLATINUM, oz. Troy $30-33.

Duties: Copper, 4c. lb.; zinc, 1¾c. lb.; tin, free; lead, 2½c. lb.; aluminum, 4c. lb.; antimony, 2c. lb.; nickel, 3c. lb.; quicksilver, 25c. lb.; bismuth, 7½%; cadmium, 15c. lb.; cobalt, free; silver, free; gold, free; platinum, free.

Ingot Metals and Alloys

	Cents lb.	Duty	U. S. Import Tax*
No. 1 Yellow Brass	7.75	None	4c. lb.[1]
85-5-5-5	9.25	None	4c. lb.[1]
88-10-2	12.50	None	4c. lb.[1]
80-10-10	11	None	4c. lb.[1]
Manganese Bronze (60,000 t. s. min.)	9.75	None	4c. lb.[1]
Aluminum Bronze	14.00	None	4c. lb.[1]
Monel Metal Shot or Block	28	25% a. v.	None
Nickel Silver (12% Ni)	11.75	20% a. v.	4c. lb.[1]
Nickel Silver (15% Ni)	14.00	20% a. v.	4c. lb.[1]
No. 12 Aluminum	16.25-19	4c. lb.	None
Manganese Copper, Grade A (30%)	22-27	25% a. v.	3c. lb.[1]
Phosphor Copper, 10%	14.00	3c. lb.	4c. lb.[1]
Phosphor Copper, 15%	15.00	3c. lb.	4c. lb.[1]
Silicon Copper, 10%	20.50	45% a. v.	4c. lb.[1]
Phosphor Tin, no guarantee	50-60	None	None
Iridium Platinum, 5% (Nominal)	$35	None	None
Iridium Platinum, 10% (Nominal)	$37	None	None

Old Metals

Dealers' buying prices, wholesale quantities:

	Cents. lb.	Duty	U. S. Import Tax
Heavy copper and wire, mixed	5 to 5¼	Free	4c. per pound on copper content
Light copper	4 to 4¼	Free	
Heavy yellow brass	3⅛ to 3⅜	Free	
Light brass	2½ to 2⅞	Free	
No. 1 composition	4½ to 4⅝	Free	
Composition turnings	4¼ to 4½	Free	
Heavy soft lead	3¼ to 3⅜	2⅛c. lb.	None
Old zinc	2 to 2¼	1½c. lb.	
New zinc clips	2¾ to 3	1½c. lb.	
Aluminum clips (new, soft)	11½ to 12	4c. lb.	
Scrap aluminum, cast	4 to 4¼	4c. lb.	
Aluminum borings—turnings	4	4c. lb.	
No. 1 pewter	22 to 23	Free	
Electrotype	3⅝ to 3¾	2⅛c. lb.*	
Nickel anodes	29 to 30	10%	
Nickel clips, new	30 to 31	10%	
Monel scrap	7½ to 13½	10% av.	

* Duty is under U. S. Tariff Act of 1930; tax under Section 60 (7) of Revenue Act of 1932.
[1] On copper content. [2] On total weight. "a. v." means ad valorem.

* On lead content.

Wrought Metals and Alloys

The following are net BASE PRICES per pound, to which must be added extras for size, shape, quantity, packing, etc., or discounts, as shown in manufacturers' lists, effective since May 20, 1938. Basic quantities on most rolled or drawn brass and bronze items below are from 2,000 to 5,000 pounds; on nickel silver, from 1,000 to 2,000 pounds.

Copper Material

	Net base per lb.	Duty*
Sheet, hot rolled	17⅛c.	2½c. lb.
Bare wire, soft, less than carloads	13⅛c.	25% a. v.
Seamless tubing	17⅝c.	7c. lb.

* Each of the above subject to import tax of 4c. lb. in addition to duty under Revenue Act of 1932.

Nickel Silver

Net base prices per lb. (Duty 30% ad valorem.)

Sheet Metal		Wire and Rod	
10% Quality	25⅝c.	10% Quality	28¼c.
15% Quality	27¾c.	15% Quality	32⅝c.
18% Quality	29 c.	18% Quality	35⅞c.

Brass and Bronze Material

	Yellow Brass	Red 80%	Comm'l. Bronze	Duty
Sheet	15⅝c.	16⅜c.	17¼	4c. lb.
Wire	15⅞c.	16⅝c.	17⅜	20%
Rod	11⅝c.	16⅝c.	17⅜	4c. lb.
Angles, channels	24⅛c.	24⅞c.	25¾	12c. lb.
Seamless tubing	18⅜c.	18⅞c.	19⅝	8c. lb.
Open seam tubing	24⅛c.	24⅞c.	25¾	20% a. v.

U. S. Import Tax 4c. lb. on copper content.

Tobin Bronze and Muntz Metal

(Duty 4c. lb.; import tax 4c. lb. on copper content.)

Net base prices per pound.	
Tobin Bronze Rod	17½c.
Muntz or Yellow Rectangular and other sheathing	18⅞c.
Muntz or Yellow Metal Rod	15 c.

Aluminum Sheet and Coil

(Duty 7c. per lb.)

Aluminum sheet, 18 ga., base, carload lots, per lb.	33.00c.
Aluminum coils, 24 ga., base price, carload lots, per lb.	28.50c

Rolled Nickel Sheet and Rod

Net Base Prices

Cold Drawn Rods	50c.	Standard Cold Rolled Sheet	49c.
Hot Rolled Rods	45c.		

Monel Metal Sheet and Rod

Hot Rolled Rods (base)	35c.	No. 35 Sheets (base)	37c.
Cold Drawn Rods (base)	40c.	Std. Cold Rolled Sheets (base)	39c.

Silver Sheet

Rolled sterling silver (May 27) 45c. per Troy oz. upward according to quantity. (Duty, 65% ad valorem.)

Zinc and Lead Sheet

	Cents per lb. Net Base	Duty
Zinc sheet, carload lots standard sizes and gauges, at mill, less 7 per cent discount	9.75	2c. lb.
Zinc sheet, 1200 lb. lots (jobbers' prices)	10.75	2c. lb.
Zinc sheet, 100 lb. lots (jobbers' prices)	14.75	2c. lb.
Full Lead Sheet (base price)	7.25	2⅝c. lb.
Cut Lead Sheet (base price)	7.50	2⅝c. lb.

Block Tin, Pewter and Britannia Sheet

(Duty Free)

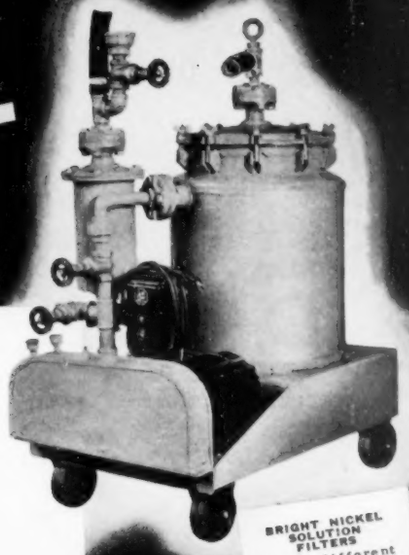
This list applies to either block tin or No. 1 Britannia Metal Sheet, No. 23 B. & S. Gauge, 18 inches wide or less; prices are all f. o. b. mill:

500 lbs. over	15c. above N. Y. pig tin price
100 to 500 lbs.	17c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price

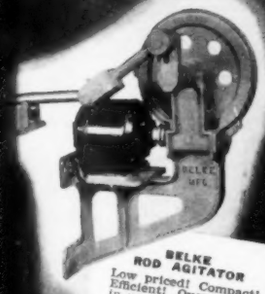
Supply Prices on page 316.

Special Equipment for BRIGHT NICKEL

RUBBER LINED TANKS
Sheet Rubber Sprayed Rubber
No matter what bright nickel solution you decide on we can furnish the proper rubber lining for the job.



BRIGHT NICKEL SOLUTION FILTERS
Seven different sizes to choose from. Capacities from 300 to 2,000 gallons per hour.



BELKE ROD AGITATOR
Low priced! Compact! Efficient! Over 5,000 in use. Immediate delivery. Single or double rod types.

TANK RHEOSTATS
Particularly adapted for bright nickel. The only rheostat on the market offering single amperage steps from 1 to 10,000.

STREAM LINED ROD AGITATOR
Keeps the work continuously moving into fresh solution. Prevents gas bubbles and burning. Four times faster plating.

IN keeping with its reputation of being first with the latest development for the plating industry the Belke Manufacturing Company now offers seven important products especially designed for Bright Nickel Solutions.

. . . Rubber lined tanks for every type of solution.

. . . Rod agitators to increase efficiency and speed up plating.

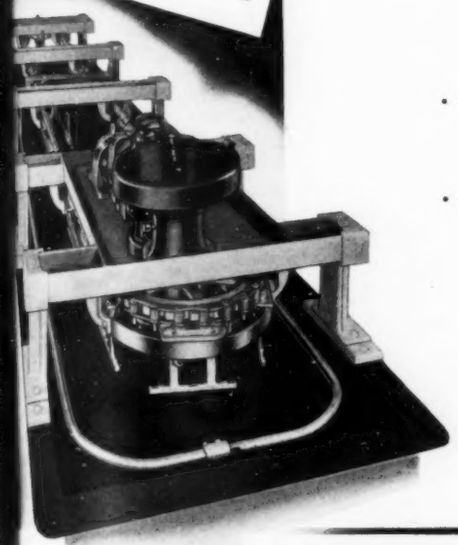
. . . Semi-Automatic Conveyors with a double cathode track to carry the increased current necessary for Bright Nickel.

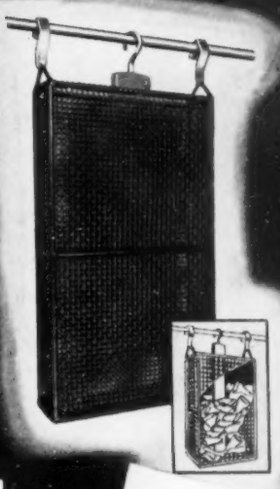
. . . The Scrap Anode Basket to use up all small pieces of Bright Nickel Anodes.

. . . Rubber Insulated Plating Racks for Bright Nickel and Chrome with spring type contacts for positive conductivity.

If you already have or are contemplating a Bright Nickel installation let a Belke Engineer assist you in getting the most out of your solution.

Write for complete bulletins on any of the above products!





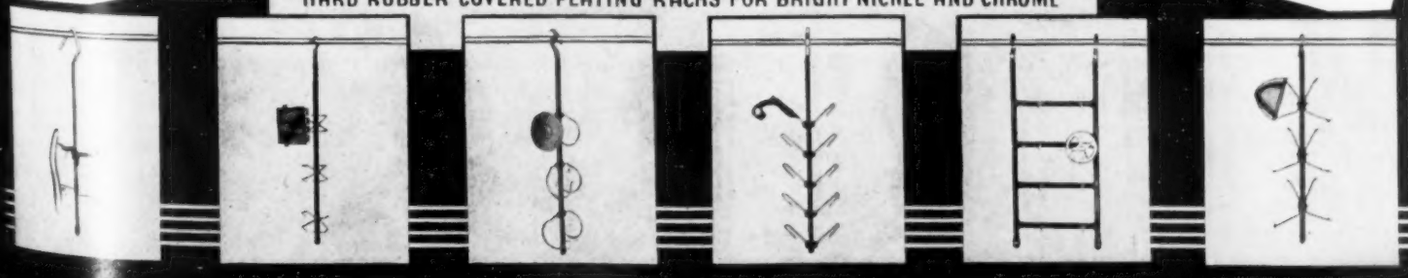
SEMI-AUTOMATIC PLATING CONVEYOR
Rugged! Efficient! The double cathode track will carry 6,000 amperes from one lead-in. Any conveyor for Bright Nickel.

BELKE SCRAP ANODE BASKET
Uses up all scrap pieces of anode. Will pay for itself in 30 days. The biggest money saver in the plant.

BELKE MANUFACTURING CO.

947 N. Cicero Avenue, Chicago, Ill.

HARD RUBBER COVERED PLATING RACKS FOR BRIGHT NICKEL AND CHROME



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CONTENTS

DEPARTMENTS

***METAL INDUSTRY** articles are listed regularly in the Engineering Index and the Industrial Arts Index.*